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ABSTRACT

The United States Department of Education's National Diffusion Network (NDN) has selected a number of science education programs to make available to schools across the country. The Life Lab Science Program (LLSP) is one such program. LLSP is a garden-based science and nutrition curriculum designed to raise students' level of science knowledge, and improve student attitudes toward the study of science and its applications to real-life problems through gardening. This study examined the nature of LLSP in school settings. Five elementary schools with LLSP experience were selected and described primarily from interviews from site visits. Discussions of the findings are categorized as follows: (1) Factors in a Successful Program; (2) Teacher Ability; (3) Students' Learning; (4) Transforming Science Education; and (5) Implementation. The strengths and weaknesses of LLSP are discussed. Interview questions used are appended. Twenty-nine references are listed. (YP)

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CASE STUDIES
IN
SCIENCE EDUCATION
AND
THE LIFE LAB
SCIENCE PROGRAM

by

Michael Arenson

UNIVERSITY OF CALIFORNIA
SANTA CRUZ
1989

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To Gary Appel, Lisa Glick, and Roberta Jaffe

for enriching the lives

of teachers and children,

and caring for the Earth.

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CHAPTER 1. INTRODUCTION

> *"It's surprising. The kids in a typical classroom don't say anything all day . . ."*
>
> *Elementary school teacher*

Our nation is in a crisis in science education. Students are graduating high school with little knowledge of the basics in the natural sciences, and little understanding of how science is applied in the real world. Recent studies have shown that across the grades in elementary and secondary education students achievement in science is declining (ETS. 1988). Internationally, in a survey of 17 countries, the United States was ranked near the bottom in achievement in science and math (IAEEA. 1988).

This ignorance and inexperience with science has both subtle and dramatic impacts on our society. A lack of knowledge about science acts in several different arenas of life. In the personal arena, people do not know how the natural world works. The ways of the world are a mystery. Without an adequate background in science people avoid solving this mystery, creating mystification in their own lives. In the social and business arena, people must face a world which is increasingly technologically complex. High technology is imbedded in modern industrial culture (Roszak. 1986). Our democratic society demands a technically literate public made up of informed, involved, and effective citizens. Without an educated public, people will make important decisions based on ignorance, or rely on so-called experts to guide their future. In addition, the National Commission on Excellence in Education argues that a scientifically literate public is essential for the United States to remain economically competitive in the world market (A Nation at Risk. 1984).

A number of issues underlie the problems we are having in science education today. These problems include poorly qualified teachers, lack of institutional support for science education, and inappropriate curriculum (Knapp. 1987). Historically, the way science has been taught is through rote methods and memorization (Pallrand and Lindenfeld. 1985). For many students, science is "boring", irrelevant, a fragmented collection of knowledge.

Educators are slowly becoming exposed to the theories and ideas put forth by Piaget and others, which emphasize cognitive learning, the stages and processes in human development of learning and understanding. Innovative science programs are now under development and in practice which draw on these theories.

One response has been to develop curriculum that engages students experientially in scientific investigation and application. These programs are called by some educators "experiential science education". Characteristics of experiential science education include: a focus on the process skills of science, inquiry or discovery-based approach to learning, hands-on activities, integrative study (of all subjects such as reading, writing, social studies, music, etc), and social relevance. There are a growing number of programs that rely on some or all of these characteristics (USDOE 1988).

A good science program needs to be supported by an effective implementation. Implementation involves a number of factors, including dissemination of curriculum, institutional support, retraining teachers and overcoming teachers resistance to change, and teacher/school ownership of curriculum (Olson 1982, Mitchener. 1989).

The U.S. Department of Education's National Diffusion Network (NDN) has selected a number of "science education programs that work" for dissemination across the country. The Life Lab Science Program (LLSP) is one such program. Life Lab (LL) is a garden-based science and nutrition curriculum, designed to "raise students' level of science knowledge, and to improve students attitudes toward the study of science and its applications to real life problems" through gardening (JDRP. 1987). Developed over a period of several years, the Life Lab Science Program is currently being used in over 250 elementary schools across the country. In its short history it has been recognized for excellence by the California Department of Education, the National Science Foundation, and the National Science Teachers Association. Most recently the National Academy of Sciences has recognized Life Lab as "the most successful example of an elementary program teaching science through agriculture in the United States" (National Academy of Sciences. 1986).

STATEMENT OF THE PROBLEM

While a number of studies have cited Life Lab for excellence, a considerable amount of research remains to be done on the implementation of the Life Lab Science Program, and science achievement. The few studies of Life Lab have taken place in the community where it originated, Santa Cruz California. There are no published studies which have described Life Lab implementation in schools outside of this district.

In addition to a lack of information on Life Lab implementations, there have been few studies on the effect of Life Lab on students knowledge of science. Two of the key questions concerning this are "Are students getting enough science?" and "Is Life Lab science or gardening?" . Furthermore, no longitudinal studies have been done which show the long term effects of the Life Lab Science Program on students or teachers, or science performance in a variety of settings. Given the rapid dissemination of this program, and other project objectives, further research is warranted.

The purpose of this study is to take a broad look at the Life Lab Science Program as it is being implemented in a range of schools, to see what is actually happening with the program at a few schools which have adopted Life Lab. This study asks "What is the nature of Life Lab in the school setting?" The following general questions help shape the nature of this research:

1) What are the broad educational goals in the school?

2) What are the characteristics of science teaching in the school?

3) How is Life Lab Science Program incorporated into the school's total science program?

4) How does the Life Lab workshop and curriculum affect teachers, their classroom, the students, and science teaching?

While the issues of science achievement and "science versus gardening" are important, answering them is not the primary focus of this research.

CHAPTER 2. LITERATURE REVIEW

> *You can say all you want in terms of having content and curriculum, but when the teacher goes into their room they do what they do anyway.*
>
> *Elementary school principal*

This chapter helps establish the context for this study. Briefly, it presents a definition of science, describes the implications of theories in cognitive development for science teaching, experiential and integrated education, and the Life Lab curriculum and research.

Science is a way of knowing. The word is derived from the Latin *scientia*, meaning "to know, or having knowledge" (Webster. 1967). The way that one acquires knowledge is through "any of various intellectual activities concerned with the physical world and its phenomenon and entailing unbiased observations and systematic experimentation." (Encyclopedia Britannica). Science, as we use it here, is a way of knowing about the physical world. But more essential than this is the curiosity, the urge to discover, the need to know, that motivates the individual and humankind to pursue knowledge, to seek truth.

This process of discovery and creation is at the core of the human experience, the foundation upon which we live and grow. Jean Piaget described a model of human development which reflected this experience. His model is particularly appropriate to education because he focused on a series of developmental stages a child evolves through into adulthood (Philips. 1981). Preeminent in this theory is that the child is constantly creating and recreating his/her own model of reality, achieving mental growth by integrating simpler concepts into higher level concepts at each stage. Piaget's concepts caused a reevaluation of ideas about learning and education. The actual stages of development proposed by Piaget have remained controversial, but the idea or the individual as the molder of his/her own reality has become well-established (Driver. 1985).

This difference between the learner as receiver of knowledge and the learner as creator of his/her understanding of the world is the underpinnings of much of the work and research in science education today, combined with an understanding of the social relevance of scientific knowledge. Linn points out that "teaching correct scientific ideas requires restructuring the concepts that children have, rather than simply supplying the correct concepts." She cites the importance of "identifying and articulating the learners' ideas and thinking skills within a subject matter domain as a basis for designing instruction" (Linn. 1987).

Among her recommendations for science education are discovery learning, teaching meta-reasoning, emphasizing the intuitive perspective and students world view, covering topics in-depth, recommending that selected topics should reflect fundamental problems in the discipline, and that science courses should integrate fundamental concepts in biology, physics, chemistry and earth science.

Other research in elementary science education supports this. Mechling and Oliver report that student performance increases with activity-based science, and hands-on science (Mechling and Oliver. 1983).

Experiential and integrated science education is receiving recognition and support by two of the largest public education groups: the U.S. Department of Education, and the California Department of Education. The U.S. Department of Education, through the National Diffusion Network (NDN) has been promoting "Science Education Programs That Work", a collection of exemplary educational programs and practices (USDOE. 1987). Many of the characteristics of experiential and integrated science education are common to the dozen science programs described in their booklet, including a focus on basic skills, hands-on activities, field experience, social issues, and the inquiry or discovery approach.

"NDN makes programs available for adoption by schools, colleges, and other institutions. . . It does so by providing funds to exemplary programs. . . and to State Facilitators whose job it is to serve as matchmakers between NDN programs and schools and organizations that could benefit from adopting the programs" (USDOE. 1987). As of February 1987, approximately 406 programs had been approved. The Life Lab Science Program is one of these programs.

In California, a soon to be released version of the new State Science Framework, by the California State Board of Education, places an emphasis on a thematic approach to science content (California State Board of Education. March 1989). In this revised framework they state "the general trend [of science curriculum] has been to reduce and compartmentalize science content to the point that isolated facts and concepts have become the focus of activities in the science classroom. . . This has unintended negative consequences."

> *Central in this report is a need for a thematic approach to science instruction, a conceptual basis to demonstrate the connections that exist among the various disciplines of science . . . [Expectations for science education include]: 1) major ideas underlying science are developed and deepened through a thematic approach, 2) the major scientific fields of study are addressed each year and the connections among them, are drawn, 3) character of science is represented as open to inquiry and controversy, 4) science is presented in connection with its applications in technology and implications for society, 5) hands-on experiences are integral to instruction, 6) students construct*

> *the important ideas of science through inquiry and investigation, 7) multilevel instructional strategies for access for all students, 8) interesting printed and written materials, 9) texts are not the sole source of curriculum, 10) assessment programs are aligned with the instructional program.*

The Life Lab Science Program incorporates many of these goals in its curriculum. Life Lab began at Green Acres School in Santa Cruz California in 1979. Following the publication of *The Growing Classroom* : A Living Laboratory Science and Nutrition curriculum in 1982, the program quickly spread to other area schools. *The Growing Classroom* curriculum contains 3 volumes: Book 1--Getting Started, Book 2--Science, and Book 3--Nutrition, and is accompanied by a scope and sequence. These teachers' manuals contain many low-cost activities, as well as guidelines for establishing the living laboratory, an outdoor and/or indoor garden.

The Life Lab curriculum emphasizes hands-on science activities, an integrated curriculum, and cooperative learning techniques to enhance the quality of student interactions and learning. There is no textbook. Life Lab recommends that teachers have students create journal, made up from the handouts, graphs and written assignments. Rather than report their research according to the traditional scientific method, students use a method called "Guess, Test, Tell"; guess what is going to happen, test it out and see what happens, then tell what happened.

Life Lab is disseminated nationwide partially through the U.S. Department of Education National Diffusion Network. They offer a two-day training workshop for teachers in which all schools are required to participate. In the workshop teachers use the Life Lab curriculum, get hands-on experience with the garden and science activities, and discuss strategies for implementing Life Lab at their school and in their community.

While there is no such thing as a perfect Life Lab, the following items were mentioned as "characteristics of a successful Life Lab school program" (L.Glick, Program Director Life Lab Science Program). They may be found in part or in whole, in any school with a Life Lab program:

- Classroom instruction: 1 to 2 hours per week, indoors and out; garden is used to teach science; other science materials are used, and coordinated with Life Lab materials
- Site Development: outdoor garden with 1 to 2 beds or planting areas per classroom; earth/soil areas with composting, soil mixing, seedling growing areas and worm project; weather station and greenhouse; market garden, staffing, such as volunteers or teaching aide; school and community workdays; garden as a community area for whole school to use.
- Program Implementation: active Steering Committee establishes goals, plans and implementation for program; special events are held, such as dedication of Life Lab, fund raisers, donations, and annual celebration; district commits financial support and resources for materials, release time for teachers, grant writing, and promotion of program in community; community support via local colleges, garden clubs, cooperative extension or soil conservation service, parent volunteers.
- Evidence of Student interest: attitudes, such as enthusiasm, cooperation, positive attitudes about science, feel successful; high participation rates; students initiate projects; improved writing and math skills; Life Lab/science interests show up in other areas of study; bring in things from home

Apart from numerous newspaper articles, intern reports and two academic performance reports, there has been surprisingly little research done on the Life Lab Science Program. In regards to student achievement, two studies have been reported. In 1981, the Title IV-C Evaluation Study found that Life Lab students in four schools made significant gains (p<.05) on standardized science tests (SAT and MAT) in science achievement at all grade level examined. (Twomey. 1982) In a study done in 1985, Life Lab students in grades 2-5 were found to have made significant gains (p<.01) relative to comparable control groups on the CTBS Science Subtest (McKay. 1985). While academic performance is important for any science program, it is not the focus for this study.

In regards to implementation of Life Lab programs, no studies have been found. While the staff of Project Life Lab (project directors, curriculum writers and administrators) have considerable experience with Life Lab in the local community, there are no detailed accounts of the implementation of the Life Lab Science Program in other schools.

This research will establish a small database of actual Life Lab Science Program sites and their experiences, that can be used to improve the curriculum materials, outreach, and overall project development.

CHAPTER 3 RESEARCH METHODS

> *I have no data yet. It is a capital mistake to theorize before one has data. Insensibly one begins to twist facts to suit theories, instead of theories to suit facts.*
> *Sherlock Holmes*

This chapter describes the research methodology used in the preparation of the case studies. It includes discussion of the selection of the sites, confidentiality of data, data gathering, and data analysis.

This research was carried out through qualitative methodology. The purpose for using this approach for evaluating science education was that it could provide a rich and textured picture of the schools and their science programs. As stated in the "Overview" in the well-known *Case Studies in Science Education*, "Our plan was to describe what we found in a way that would be useful to any other person who could not be there to visit for himself." (Stake and Easley 1978). I have tried to remain true to this plan. At the same time I have tried not to presuppose theories of what I expected to find at the sites, but have left room for the cases to "tell their own stories".

SELECTION OF SITES

The case studies were carried out at five sites; one each in San Jose California and Eastern Massachusetts, and three in Washington D.C. All of the sites had some experience with the Life Lab Science Program. The sites were selected based on a representation of a diversity of environmental, social, and educational factors for the community and student populations. These factors were socioeconomic levels, urban or rural areas, geographic distribution (location and climate), and length of time with the Life Lab Science Program. The final school selections were made in cooperation with the Project Life Lab directors and research staff. While it was my original intention to visit two sites, the scope of the research quickly grew to the selected five sites.

Table 1. Summary of selection criteria for case study sites

School	Social characteristics	Urban/rural	Climate
Marsh	multicultural/low income	urban	mild winter
Eastern	Anglo/middle income	rural	cold winter
Alexander	primarily Black/low income	urban	cold winter
Barney	primarily Black/low income	urban	cold winter
Carson	pri. Black and Anglo/low income	urban	cold winter

Table 2. Selected Characteristics of Schools' Experience with Life Lab

School	Time with Life Lab	Number of Teachers Trained	Life Lab Garden Established
Marsh	5 years	15 or more	Yes
Eastern	2 years	18 or more	Yes
Alexander	1 year	2	Yes
Barney	less than 1 year	5	No
Carson	2 years	4	No

CONFIDENTIALITY OF DATA

The original data is kept in strictest confidence between the researchers and the participants in the study. No names of participants have been used in these reports. The school name and location have been fictionalized. Permission to tape record interviews was received from all but two participants. Those who declined to be recorded were still interviewed, but the depth of the data from these sources is less complete. Student participants were required to receive written permission from their parents or guardians.

DATA GATHERING

The data collection process spanned a period of six months, from October 1988 through March 1989. The site visits were conducted in December, February and March. At two of the schools the site visits lasted four days each. At the Washington D.C. schools the site visits were one day each.

The primary tools for collecting data were through interviews, observations of behaviors, and collection of artifacts (Patton. 1980, St. John.1988). The interviews were conducted in a variety of settings. Interviews with administration were conducted individually in private office settings; with teachers, individually or in focus groups; with students, in small groups. Most interviews lasted from thirty minutes to one hour. Observations were made during school hours, in classrooms or outdoors where the teachers and students were working. In any one school several classes were visited. No specific format was followed for these observations but, in general, each observation included a general description of the setting and a more detailed description of the activity. Artifacts included documents made accessible by administrators, teachers, and students.

The majority of the data collected and analyzed were based on the interviews. A complete set of questions was prepared, built around a number of themes: The School in the Community, Life Lab in the School Context, Science Teaching Present Practices, Impacts of Life Lab on Teachers and Students, Evaluating the Different Aspects of Life Lab, and Costs and Funding. A detailed list of these questions can be found in Appendix A. Since it was not practical to ask all of the questions of each person in any one sitting, specific questions were selected based on the amount of time and who was to be interviewed. Time was available in each interview for impromptu discussion as well.

DATA ANALYSIS

The model for the data analysis used was a synthesis of methods described by Yin (Yin 1984), Merriam (Merriam. 1988), and Miles and Huberman (Miles and Huberman. 1984). Yin says that the ultimate goal of the analysis is 1) treat the evidence fairly, 2) produce compelling analytic conclusions, and 3) rule out alternative interpretations. In what he calls "explanation building", an initial theoretical statement is compared with findings in the case. The statement is revised, compared again with the data, and revised again "as many times as needed." Miles and Huberman describe a process where the researcher seeks to identify "an emergent theme or pattern", known as "pattern codes". The data is coded according to certain categories based on these patterns. Merriam describes a process in which the researcher reads the data several times, making notes, drafting the notes into a primitive outline, leading to the creation of categories. Then the data is coded based on the categories, and sorted into the categories. These categories then reveal patterns.

In these case studies I developed a method which drew from all of these sources. The approach I used for each case was:

- extract a preliminary set of categories from field summaries of the data
- develop a coding system based on these categories
- review the data several times and code it, modifying and adding to the coding system as appropriate
- write a crude outline, supporting or challenging each of the categories
- revise categories, codes

- write a statement for each pattern, code the pattern
- review the data with new categories and codes
- expand outline, featuring compelling patterns which have emerged
- write case study, supporting each pattern with detailed quotes and references drawn from the data

In general, a number of common categories emerged from each case study. These were very similar to the categories built around the original set of detailed questions. The patterns were also similar across the cases, but no effort was made to generalize these patterns within the case studies. Each case study was written by itself, with whatever wording or patterns that came through in its own unique analysis and presentation.

CHAPTER 4 THE FIVE CASE STUDIES

This chapter contains the case study reports prepared for each school. In addition to the five individual reports, there is an introductory report for the Washington D.C. schools. As stated in the previous chapter, the school names, locations, and participants have been fictionalized to maintain confidentiality.

MARSH ELEMENTARY SCHOOL, SAN JOSE CALIFORNIA

> *The teacher I have become has been influenced by Life Lab. The things I wanted to know about as a teacher were influenced by my experiences with Life Lab.*
>
> *Third grade teacher*

This report presents a case study of the Life Lab Science Program at Marsh Elementary School in San Jose California. Dr. Mark St. John and I visited Marsh for four days (December 5 - 8, 1988), and met with teachers, students, school personnel and administrators, and spent time observing in the classrooms and on the school campus.

This report is organized around the following subject headings: Summary Statement, School and Community, School Leadership and Curriculum, Science Teaching and Life Lab, Teacher Training, and Discussion.

SUMMARY STATEMENT

Marsh serves students from diverse multi-cultural backgrounds. Many of the students are from immigrant families, living on low incomes. The school's educational philosophy emphasizes the social and cultural development of the children. In practice, cooperative learning and hands-on learning are integrated into the curriculum. Life Lab is very much a part of the school's culture and science curriculum. It has been growing at Marsh for five years. There is a large garden which is productive the entire school year, and is a center of activity. Over half the teachers are involved with Life Lab science, at all grade levels. There is a paid part-time aide in the garden. The principal and the Mentor Teacher provide the on-going leadership which sustains the program. And it is also strongly supported by the administration and the local community. Students identify Life Lab as one of their favorite school subjects.

SCHOOL AND THE COMMUNITY

Marsh is located on the east side of San Jose California, surrounded by tract homes, freeways, and open spaces. While certain areas of San Jose are especially prosperous, this particular neighborhood is home to low-income families of many different cultures. Many of the students at the school are immigrants, some coming to the area in the last year. Others have been here much longer. Their families come from countries south of the U.S. border, Asia and Southeast Asia.

The school site occupies an area of 10 to 15 acres. Much of this area is open grass playing field. The school buildings themselves are single-story light blue rectangles, grouped in one area of the campus, with 4 or 5 classrooms per building, and 6 or 7 main buildings on the campus. Some of these buildings were built on-site, while others are trailers that have been permanently established on the site. There is a large asphalt playing area adjacent to these buildings, where students play tetherball, four square, basketball, and other sports.

The Life Lab garden is located at the northwest corner of the school lot, adjacent to the main road and teacher's parking lot. It is surrounded by a sixteen-foot-tall storm fence, capped with barbed wire. The garden area is approximately 5000 square feet (100'x50'), and contains 12 main garden beds (3'x24' each), several picnic tables, a large tool shed, and compost area.

Marsh has had a Life Lab program for five years, and over half of the teachers have been to Life Lab workshops. In the past, the Mentor Teachers have been responsible for managing the school's Life Lab program. Recently, the school hired an aide who coordinates the Life Lab activities and helps maintain the garden. She works, officially, 2 hours a day, Monday through Friday, but often volunteers additional hours.

- **The student body at Marsh is culturally diverse, with one-third of the student population of limited English speaking proficiency.**

The school has an ethnic mix of 30% Hispanic, 30% Asian, 10% Black, 12% Filipino and 12% White. One-third of the students are of limited English speaking proficiency. Many of the students are recent immigrants, while others have been here for several years. Their families come from countries such as El Salvador, Mexico, Vietnam, the Philippines, Hong Kong, China and Cambodia. One student from Vietnam remarked, "I travelled all around the world to go to the United States."

- **The philosophy and practices of education at Marsh focus on the social and cultural development of the children, fostering positive social and educational experiences.**

The students at Marsh are largely from poorer families. As one administrator described it, "The socioeconomic level in this area is very low. Thirty five to thirty eight percent of the families of the students in the school are on ADC or welfare. Many of the students are from single-parent families."

When asked to describe the culture of the school, the principal said "We try to keep it a school that is kind of a little safe oasis in the children's lives. I think the teachers and everybody at the school tries to make it as positive as possible."

Themes such as self-esteem, cooperative learning, hands-on learning, and personal health are found in many classrooms, and integrated into the overall curriculum. The principal outlined several of the main priorities at the school. She said, "Both self-esteem and cooperative learning are fairly extensive components of the curriculum. All of the teachers have been trained in both of these areas. The students are actually trained in how to do cooperative learning projects or techniques. Also, science, and health and physical education have special emphasis in the school, and Life Lab is a big part of this."

- **Life Lab is very much a part of the school's culture.**

The nature of the Life Lab approach to science education reinforces these themes and priorities. In particular, cooperative learning and hands-on science address these needs. The principal pointed out that cooperative learning "is a strong strand in the Life Lab program." When asked about the impacts that the Life Lab program has on students, the principal said, "It's the enjoyment that they get out of it, that contributes to their life in school, that contributes to the positive environment."

An instructional aide in the garden explained how students benefit from cooperation in the garden. She said, "In the garden they learn to work male-female, among ethnic groups, and working in teams, as groups or individuals. They'll intermingle to try and find the answer, or work together in the plot. I think the cooperation that we're trying to push out here is most beneficial. Out here we're all one."

Several teachers discussed their goals for their students, through their work with Life Lab. They mentioned self esteem, cooperative learning, discovery, excitement, respect for nature, respect for themselves, and responsibility. Other teachers said "I want my kids to understand that they are taking care of the earth", and "It teaches them to be citizens." One teacher said "I really believe in hands-on learning and doing something that's real."

One administrator said that she thinks Life Lab helps students use and improve their language skills. She explained, "The kids in a typical classroom don't say anything all day, and especially don't say anything if you don't speak the language very well. But here's a situation [LL] where you get to use all the formal language. You say, 'Give me a pencil.' or 'Where's the ruler?' You talk about all of that good stuff, and you really expand your vocabulary."

SCHOOL LEADERSHIP AND CURRICULUM

- **Strong leadership sustains the school's vision. The principal is recognized as a central figure in maintaining this vision.**

Several people identified the leadership role the principal plays in the school. When asked how priorities are established in the school, one administrator commented, "A lot of that has to do with how the principal looks at things. It probably begins with the initial objectives meeting that the principal has with the teachers ,when they talk about what they are going to be doing that year. Some principals will insist that certain areas are covered."

The principal was dedicated to making the Life Lab program work. One administrator, who worked with the principal on funding for Life Lab, told a story about the principal's commitment. She said, "Like all principals they only have so much time. But when the teachers wanted to do Life Lab, the principal supported it. She gave them the little bit of funds that were available, and helped them with writing their grants. When Life Lab was just getting started, I came to visit during the summer. The principal was out in the garden digging around. She was going to have some crops growing when school started. I think she was planting pumpkins. She knew she had to plant them in the early summer so they would be ready for the fall."

The teachers also acknowledged the important role of the principal supporting Life Lab. One teacher said, "She is very supportive of Life Lab, especially with funding. She comes out to the garden time and again to see how things are going. This is one of her babies. If you didn't have your principal behind you, then when you go to her and say 'I need this', that will go down at the bottom of her list. She thinks Life Lab is very important, so she puts Life Lab right up there."

- **Leadership and support for Life Lab has also come from outside the school.**

The District administration, the State Department of Education, and community businesses and organizations, are supportive of the Life Lab program. "When the program started", one person explained, "the School Board and the superintendent were enthusiastic. They were glad to have the recognition to be selected to be part of the Life Lab pilot. They sank a lot of money into it. Since then they have promoted it in the other schools." The principal pointed out that when the school started their Life Lab program the district paid for the fencing and plowing and did the work.

A school administrator commented, "What I do notice about Marsh, is that there is a tightly linked curriculum that is followed pretty closely by the teachers, and monitored by the principal. We find their scores continue to increase every year, in all areas. We are very very proud of that. They have a lot of language minority students there, yet the reading scores increase, the language scores increase, along with the math and science. Talking to the principal you get the feeling she watches very closely how that curriculum is structured."

The principal commented on the connection between the State of California educational frameworks and their school. She said, "California, with these frameworks they have published, has taken tremendous leadership, really revolutionized the teaching in certain areas. The ideas and the philosophy behind what the State is trying to do is very innovative. For example: cooperative learning is right there in the middle of the curriculum that is coming from the State now."

One community group, the Dads Club, has offered on-going support for Life Lab. The principal explained, "We've got a very active Dads Club. They were always willing to put in a lot of money. The gardening associations are so happy that young people are learning about gardens, plants, flowers and vegetables, they were very happy to donate." Another person added, "Gardening is the biggest hobby in the country, so you've got lots of volunteers out there. You've got the Begonia Society, and the Roses Society. Every once in a while the gardening editor at the newspaper will write some articles about the school gardens."

During the past four years a number of area businesses have contributed money or materials to the Life Lab program, including Hewlett-Packard , Southern Lumber, Burke Industries and Orchard Supply and Hardware. The local community college has also been involved with Life Lab. For example, students from construction classes at San Jose City College built the garden tool shed on-site, as part of their course work.

A bond measure was recently passed within the school district, which included support for Life Lab. The measure authorized the sale of $15 million worth of bonds over the next five years so the school district can make capital improvements. Some of this money from these bonds has been budgeted for Life Lab.

- **The Mentor Teacher has taken on leadership of the Life Lab program.**

A Mentor Teacher is a teacher selected by the school or the district to help other teachers improve their work. At Marsh, the Mentor Teacher has been very involved with Life Lab over the history of the program. The principal explained how the Mentor teacher has been involved. She said, "There has been a Mentor Teacher around almost all the time we've had Life Lab. She was very instrumental in helping us get started. Mentor Teachers get extra money and release time. So ours had that time to go around, talk to the industries and businesses, get donations, and meet with the teachers and plan some lessons. She did a great deal of work on Life Lab at the beginning. We have had another Mentor Teacher since then. She has taken a tremendous interest in the garden. She works with the other teachers and really makes it so they can do Life Lab without a real struggle."

An administrator also noted how important the role of the Mentor Teacher was in the program. She said "You have to have that one person to fall back on. It has to be a person who really wants to see the program work. Without the Mentor Teacher, it wouldn't have hung together. The enthusiasm she has for Life Lab really helped."

SCIENCE TEACHING AND LIFE LAB

- **The Life Lab curriculum is an essential part of the school's science program. Over half the teachers at Marsh teach Life Lab science.**

Since the programs inception five years ago, over half of the teachers at Marsh have been through the Life Lab training, and are teaching Life Lab science. Each year a few more teachers are trained, but only those who choose it. The principal does not require that the teachers do Life Lab.

When asked if Life Lab is science or gardening, the Director of Middle School Curriculum responded, "I think it's all going on. If you're gardening ,you're doing science. If you're doing oral language you're doing lots of things. And I think most of the teachers see that. Certainly the district people do, and the principals do."

One teacher explained that "Life Lab goes on all year long. It is a continuous activity." He described how science is taught in the garden, and said, "Once a week, maybe, [a class] goes out to the garden and they have some particular lesson about plants and gardening. They also have lessons that are not necessarily about gardening, but would still be about earth sciences, such as composition of the soil, ecology, and that sort of thing."

Many of the teachers teach science through an integrated or interdisciplinary approach. Art, language, reading and writing, science, math and social studies are all featured in the Life Lab program. One third grade teacher reminded us that "you have to remember that science is part of everything. If you [do science] in connection with Life Lab, it comes in at all sorts of times during the day. It's just like teaching geography. I'm not going to just teach geography during the history hour, because it comes up all the time."

Another teacher listed the many ways she brings Life Lab into her lessons. She said "We do letter writing for donations and grants; graphing, measuring; write riddles and poetry. . . .You can do anything off the garden"

Here are two examples of how different teachers teach an interdisciplinary curriculum built around Life Lab. In this first example, the third grade teacher describes some of his favorite activities, and the yearly cycle of the garden.

> *We do all kinds of things with Life Lab. For example, we do math activities with corn. They get their first ear of corn to shell. They estimate how many seeds are on that ear of corn. They shell it. Then they count, and see how close did the actual count come to the estimate. We do it again and their estimates get better. We also graph things, like how fast is a plant is growing.*
>
> *I emphasize how to grow things in the garden. We are specific in what we grow. I have it set up so that there is a harvest in the Fall, and that harvest is tied in with social studies. At the same time, we talk about about pilgrims and migration.*

> *And we also talk about ourselves, because the class tends to be immigrants, or their parents were recently immigrants.*
>
> *My favorite part is right around Thanksgiving, the harvest and sharing the harvest. Thanksgiving week we pop the popcorn we grow. We share our popcorn, talk about how the early groups had to share with each other. . .My students actually go out to the garden, get the produce, and bring it in. They have to process it--shuck the corn, shell the corn, clean the corn, and so on. We talk about 'This is what people had to do.'*
>
> *Then there will be a lull, when we let the garden lie fallow. I'll bring down compost material and horse manure. In the spring, we go out to the garden again, dig it up, prepare a seed bed, plant some plants. I try to grow things that are a little bit different than anybody else would grow. A lot of the other plots have lettuce and carrots and beets and that sort of thing. I try to grow things that get their attention in a way that they don't normally see. I'm going to try and grow some cotton. . . .*
>
> *We also use the other people's gardens. We'll go out some times and examine the other gardens. I'll have some kind of activity like measuring plants, counting the kinds of plants that are there. When they come back in we'll take that information, and consolidate it. We might make graphs from it, or we discuss the similarities and differences of different peoples' plots.*

In this second example, an English as a Second Language (ESL) teacher discusses her first-year experiences with Life Lab.

> *Life Lab is perfect for ESL because it's hands-on, learning by doing, seeing and recording. It's good for the food curriculum, and science and math. , , When we dug up the garden a lot of my students really went to it. I was amazed. They knew how to handle the tools, because they came from farms. . . These kids, oh boy, they told me what to do! They knew all about gardening, and they loved sharing what they knew.*
>
> *Life Lab really does promote cooperative learning. For example, in a math lesson we recently did, they had to measure the garden plot and divide it by the number of groups. They each made a section and each group had a responsibility for each section. It really does help them work together well.*

- **The teaching staff is highly motivated and the teachers are enthusiastic about Life Lab.**

The group of teachers at the school who have been through the Life Lab training meet regularly. Sometimes they do business, or talk about teaching and gardening problems, and share their curriculum. The teachers also do curriculum development, and planning the use of the garden for the different grades.

The principal enthused about her teachers. She said, "They are an exceptional group of teachers. They don't necessarily work harder longer hours, but they are very good. They really care about the children. Often, you hear teachers at other schools moaning and groaning about their job. Here, I've never once heard that said."

"When we first started the garden", she continued, "some of the teachers could not believe their ears. 'Gardens?' they said. 'We don't know anything about gardens.' And yet, many of those very same ones are right out there doing it."

The garden aide, who works alongside the teachers in planning and implementing their lessons, had these observations:

> *Doing Life Lab is an extra activity. This type of thing will only work as much as you put into it. If the teacher is energetic, the students are going to be energetic, share the enthusiasm. . . .There's a certain kind of teacher who will come out to the garden. They have to be one who is willing to work. With everything you have to do in the classroom, this is just like one more thing. You have to prepare the lesson and fit it into your class, and sometimes you do get dirty.*

One teacher remarked that Life Lab had transformed her teaching. She said, "The teacher I have become has been influenced by Life Lab. . . The things I wanted to know about as a teacher were influenced by my experiences with Life Lab. I have really grown as a teacher by using Life Lab in my classes."

- **Students are enthusiastic about school, and they identify Life Lab as one of their favorite subjects.**

I interviewed 19 students from a 4th and 5th grade class. I asked them several questions about their school and Life Lab. "How many of you like school?" 19 students raised their hands. I then re-phrased my question. I said, "Raise one hand if you like coming to school, and both hands if you really like it a lot." This time 18 students raised both hands, and one student raised only one.

When asked "What is your favorite subject in school?", 13 responded that Life Lab was their favorite subject. They also said that math was a favorite subject, getting 13 responses as well. The next most popular subject was physical education/recess, with 7 students responding. Most students offered more than one favorite subject, and in most cases, Life Lab was their first response.

One teacher described her experience on a field trip to the San Jose Historical Museum. Part of the museum exhibit included a vegetable garden. She said "The kids knew every plant in the garden. The docent was amazed at the kids' knowledge." She added that her students also notice other flowering plants on other field trips.

- **The Life Lab garden provides a center and focus for science activity, for all grades.**

The large garden at Marsh can accommodate several groups of students or classes at any one time. The garden is a place to work, and also to relax. A garden aide noted this. She said, "When they are out here, the teachers seem more relaxed with the students. Out here it's more one-to-one; it's not the classroom situation." One of the teachers added, "You can be on a people-to-people level. You can just talk like regular human beings when you are working in the garden with the kids."

Several different teachers offered the following ideas about the garden. One teacher spoke in favor of getting out of the classroom. She said "The limitations in the classroom are serious. For example, there is no sunlight. And you have limited space. The garden lets you experience the whole cycle of nature. Yes, the garden is very much of a feeling, of being respectful."

Another teacher described how working in the garden affects student's attitudes about school. She said, "For the kids, Life Lab gives them a sense of school spirit, identity, and ownership. . . .It certainly has taught the children to cooperate and share. . . .And lower achievers in the classroom can be leaders in the garden."

The garden aide explained that for some students, working in the garden builds leadership. She said, "I noticed if I have a student from one year to the next, and we're doing the same experiment, they'll tend to be the leader They'll tend to step out and say 'I know how that works', or will be more outspoken. By the time they come into 6th grade and they've had Life Lab for a couple of years, they know exactly what to do."

After an especially active lesson in the garden, the aide remarked, "A lot of these kids are really jazzed about Life Lab. They'll go home and try the experiments they did at school on their own soils at home. They'll take jack-o-lantern seeds they planted here home in a cup, and at the end of the summer come back all excited about what they grew. They are really jazzed."

A group of fourth and fifth grade students gave me a guided tour of the garden. They excitedly directed me to their garden bed, and each student pointed out what his or her contribution was in the garden. Students were able to identify what plants were growing there, which plants were "volunteers", and knew how long it took for the different plants to reach maturity. Among the science and gardening skills they identified were: experiments, double digging, research, steps of the scientific method, and guess what will happen.

Students also showed me some of their work which they record in their journals. Of those journals I reviewed, the basic content for each experiment was the same. But each journal contained different drawings and descriptions of the particular experiments. Some were sketchy in detail, while others were very detailed.

Here are two examples of classes I observed in the garden, as described in my field notes. In the first example, a 4th and 5th grade class is involved in three different activities over a 50 minute period. In the second example, a group of kindergarten students learn about fruits, seeds and classification.

> *A 4th and 5th grade class --*
>
> *A class of 30 students has come out to the garden for a couple of activities. The teacher demands order, then divides the students into three different groups. A few students go to the tool shed and are responsible for managing the tools today. Other students go over to their garden bed. An equal number settle in at the picnic tables to learn to write cinquains, using the garden as a theme.*
>
> *At the garden bed, the aide explains how to use the moisture meter. Working in pairs, the students each get a chance to use the meter, and scatter throughout the garden taking moisture readings in different garden plots, the compost pile, and a bucket of water. Other students, waiting to use the meter, clear pine needles from the garden bed, and thin their recently planted lettuce.*
>
> *The students are loud, vocal, constantly moving. Almost all of them are occupied, working in their garden beds, making observations, or writing poetry. Over the course of the hour, students working on one activity will switch to another activity,*

so that by the time the session is over, most of the students will have done the three planned activities that day.

A kindergarten class--
There are a group of twenty kindergartners out here today. They are sorting fruit by their seeds: apple, tangerine, orange, tomato, apricot. The seeds are on separate plates. The teacher asks them to guess which fruit goes with which seed, and has them place the fruit on the appropriate plate. He reminds them to work cooperatively, then leaves the group to work on their own.

The kids yell and discuss and argue. Within a few minutes they have sorted the fruit by their seeds. When the teacher returns, one student says, "I didn't do anything!" The teacher asks him how it felt to not be helping, and encourages everyone to be involved.

"Let's find out now, which fruit has which seeds," the teacher says. First they cut open the apple, and yes, the students correctly matched the seeds to the apple. They open the orange, but they can't find any seeds inside of it. They open the tangerine. "It smells good" one student says, and he bounces excitedly on the bench. Next, they check the tomato seeds. "It looks like you got it right" the teacher says. "You guys are doing great." He asks them how they eat tomatoes. "I like mine with sugar" one student says. Next, they compare the peach and the apricot seed. The teacher has them compare the different sizes, shapes and forms of these seeds.

They taste the apricot, and some students squeal with delight at its fresh, sweet taste. "Are seeds all the same?, the teacher asks. "Each seed makes it own kind of fruit."

One student tells the others how to say tangerine in Spanish. They practice saying the new word, and the teacher says "Now I've learned a new word".

- **The Life Lab curriculum *The Growing Classroom* is an essential, but incomplete part of the science curriculum.**

Teachers use a variety of curriculum materials, including textbooks, supplementary materials, and *The Growing Classroom.* This Life Lab curriculum is not used extensively, but it is a basis for many of the activities teachers do. Over time teachers create their own activities.

One teacher said, "I do use those, but not extensively. They have some really neat lessons in them." Another teacher remarked, "I guess the thing about *The Growing Classroom* that makes it nice is that it's one page at a time. In a textbook you look at it and you think 'Wow, it's overwhelming.'"

On the other hand, one administrator who served as a curriculum expert felt that it was "a large part of the success of their program."

TEACHER TRAINING

- **Teachers desire additional Life Lab training, guidance, and activities.**

Teachers said they were very satisfied with the Life Lab training workshops they attended, but they also would like additional training. They would like to learn more about gardening. A few teachers also suggested meeting with other teachers from other schools.

An administrator described her perspective on the need for training. She said, "In our district we have teachers even now who don't know where potatoes come from. A lot of them have been into the Life Lab and say 'Gosh, Wow'. They requested a gardener to come in and work with them for a week, to show them how to mix soil, fertilize things, water properly, and that. They don't know any of that. And that's understandable. When they attended college it was paper and pencil business and not so much gardening. So unless they had a gardening experience at home, they probably didn't know how to garden. "

She continued, "Part of the down side is that principals don't like to pay the registration for the teachers to go to two days of training and pay substitutes as well. It does run into a lot of money. And if you try to train a teacher from each grade level, that's six teachers. With subs and registration fees, it gets expensive."

DISCUSSION

Marsh could serve as a model for a successful Life Lab school. It has a large and vital garden. The teachers, students, administration and community are enthusiastic about the program. Life Lab has become a very important part of the school's culture and identity.

This is an example of a mature Life Lab program, five years in the making. It got off to a slow start, but it has grown to its present size through the care and nurturing of dedicated people. In particular, the Mentor Teacher has worked hard to keep the garden growing, and helping other teachers use Life Lab in their classes. With the help of a garden aide, teachers are able to work outdoors with smaller, more manageable, groups.

While the Life Lab curriculum *The Growing Classroom* is not heavily used, teachers have integrated basic concepts from Life Lab into their own class curriculum. The interdisciplinary approach has helped teachers make science more interesting, and relevant.

Most important, the students are enthusiastic about school and learning science. They can identify what they are learning, and some of them are transfering this knowledge to home gardening projects. At Marsh, children from around the world have found a common ground in which to learn and play, through Life Lab.

EASTERN ELEMENTARY SCHOOL, EASTERN MASSACHUS

> *I do a lot of hands-on things because that's how learned when I was young. Your hands rememb To motivate me, I've got to use my hands.*
> *Fourth grade Teach*

> *"Most kids I had out there were more excited abo a green bean or carrot than they were about cand Some of these kids would normally turn their no up at a radish, but because they grew that radish, was delicious. They had a real pride in the fact th they were eating things that they had grown.*
> *Third grade Teach*

This report presents a case study of the Life Lab Scien Eastern Elementary School, in Eastern Massachusetts. Dr. Ma I visited Eastern during the winter, for four days (February 27 - During our visit we talked with teachers, administrators, stude community volunteers. This report is organized around subject headings: Summary Statement, School and Comm Leadership and Curriculum, Science Teaching and Life Lab

growth. The town is served by one elementary school that s population. While the principal claims that the traditional "b important, the curriculum includes substantial emphasis on studies, and the arts. The curriculum at Eastern is under t guided by the principal and teachers, rather than by textbo requirements. Life Lab is an important part of their new scie but is not the sole focus for the students' science educati outdoor garden is dormant in winter, but is supplemented by well-supported indoor gardening facilities. It takes a lot of work to start a Life Lab program, and Eastern has been resourceful bringing in funds and community resources to support their program.

SCHOOL AND THE COMMUNITY

Eastern Massachusetts is not a city, and it is barely a town. The population is about 5000 people, and growing every day. Located in central Massachusetts, south of Worchester, Eastern looks much like the rest of the central state, with long rolling hills, forests, and open farmland, houses set near the winding roads. At this time of year the trees are bare, and there is a foot of snow on the ground. Eastern was founded in the early 1700's, and the character of the area is changing rapidly as more and more people are moving into the town; building houses, remodeling farmhouses, causing property values to quadruple. It is becoming a sub-urban settlement of Worchester, principally spurred by the arrival of the young professionals families. This changing demography is having an impact on the local schools.

The elementary school, the only one in the town, is located next to the high school, and it is surrounded by meadows and woods, with a few homes nearby, and open views of the rolling hills and forests. There is no lack of space for the school to grow, or have a large garden.

The school building is modern, built in the early 1970's, and is designed with a light and open floor plan. High ceilings and large clerestories run the length of the building, bringing in a great deal of light. Originally, many of the classes shared common space. These large and open spaces have since been divided, partitioned, and separated into more typical classroom spaces, but there are still many classes that share common areas. Classes are noisy and sound travels from one space to another as if there were no walls or dividers between the spaces. The constant noise was mentioned by many as the primary disadvantage of working in this school. I observed on numerous occasions teachers trying to keep their students quiet so they wouldn't disturb other classes. The advantage of this openness, is that there is a lot of communication among teachers. They know what other teachers are doing because they can see it and hear it throughout the day, unlike traditional classrooms.

The racial makeup at Eastern Elementary is White. I did not see any Black, Asian or Hispanic faces in the student or teacher population. There are about 700 students at the school. Many of them arrive in buses.

In the past two years Eastern has received two awards for national recognition. It was selected as one of 287 schools for "Excellence in Education" by the National Elementary School Recognition Program of the U.S Department of Education. This placed Eastern in the top 1% of elementary schools in the country. The other award was the National Gardening Association "Green Medalist Award" for their outstanding gardening program. This award included cash to be invested in additional gardening supplies or materials.

Life Lab is a new science program for Eastern. Initially, three third grade teachers were trained in October 1987. Then, in May 1988, another 15 teachers from the school were trained. The school now has a large garden (approximately 75'x150'), a supplies closet in the school building where tools and planting materials are stored, and a number of Grow Lab™ indoor garden units in the classrooms.

The education of the children in Eastern, and the implementation of Life Lab, is strongly shaped by the people within the school -- the principal and teachers -- and an active volunteer community. The principal is making a very conscious effort in developing the school's curriculum, which includes a long-term development effort in each of the main curriculum areas, and support for the teachers own professional development. Life Lab has required a substantial commitment from the school. More important than the specific activities in the Life Lab book is the school's vision of having a garden, and making science an essential part of the student's education. The Life Lab program, including training, is now an important part of this.

As will be described later, Eastern has many special programs that work to make up their overall curriculum. They have over 24 NDN programs (National Diffusion Network) in the school. Through a mixing and matching of these programs they are trying to create their school's curriculum. There is no mandated curriculum from the District, or maybe not even from the State, so they have a free hand to develop their own. Given this, here are the important ideas and themes I have drawn from this case study:

SCHOOL LEADERSHIP AND CURRICULUM

- **The principal is the predominant guiding force in the school, directing the curriculum development, implementing new programs, and motivating teachers. In particular, the school's process of developing curriculum is an essential part of the character of the school.**

Overall, the school emphasizes the "basics" (language arts, math, and science), but both cooperative learning and an integrated curriculum are important also.

The principal described what she saw as the main educational priorities, and programs. She cites an emphasis on the basics, curriculum development, testing, cooperative learning and the emerging importance of science.

The principal said,

> *The major priority is fostering academic growth in all of our students. We try very hard to make sure that we ensure that the academics are held first. The traditional basic skills, reading and math, get enough time every day. We try to keep interruptions down. We do quite a bit with the arts. We have an active drama and music department, and also do a lot taking kids to live performances and bringing performances in.*
>
> *This has been a school that's been recognized by the US Office of Education as part of a national network of successful schools. . . One of the things we were recognized for is the way we have been developing curriculum with our teachers.*
>
> *Test scores are very important. We have to define what is basic education, because it's more than the reading, writing, and arithmetic. I still think that comes first at an elementary level. Make sure that they have that under their belts so they can get other things.*
>
> *We want them to be excited about learning, and learn how to think, certainly not have little rote learners on our hands. We want them to be good problem solvers, but there is content that is basic they should have.*
>
> *Certainly science has to become part of the elementary basic education. Usually it's seen as a secondary subject. We did a needs Assessment and the teachers said 'We want science and social studies' and the parents said 'We want science and cultural experiences.'*

- **The curriculum in each of the main subject areas (language arts, math, science, other arts) is developed, over time, by the principal and teachers. It is not handed down through a textbook or by a Board of Education. The principal relies on outside programs, such as NDN programs, as building blocks for their curriculum development.**

The principal at Eastern plays a very active role in shaping the curriculum of the school, and making sure that money is available to support the school's programs. The Superintendent commented that the principal is "exceptional -- an idea person." He acknowledged that she was especially good at fund raising. Given the number of programs and activities at the school, fund raising is significant.

At the program level, the principal's commitment can be seen in her active involvement with the curriculum development. This development has several features: 1) the support and training for the teachers, and 2) the well-managed process of curriculum development. For example, the principal explained that she likes to accompany teachers to the initial workshops because "it is an essential part of what makes a program work." It gives her a better sense of the program that they are considering, and it allows her to get direct feedback from her teachers on that program. When considering adopting the Life Lab program at their school, the principal attended the Life Lab training workshop with two of her teachers, and also visited a school in California that had Life Lab, and met with the principal there. She said "this helped give a picture of what we were going for" in their own Life Lab program.

In recognition and support of this approach, she said "the Superintendent has been good about giving money for substitute teachers, while the regular teachers are being trained." This shows the administration's confidence in what the principal is doing. But the community support must be there also, in order to support the programs and this approach. As the principal said "Our school/district is not wealthy, relative to other schools in the State. A lot of people from other school systems come here and think that this is a money town and it's not. This town is sixth lowest in the Commonwealth in per pupil expenditures. A lot of it's done with grants, volunteers, begging, a teaching staff that is here early in the morning and late at night."

The area in which her leadership and direction was most strongly visible to us during our visit was in curriculum development.

Curriculum has to come from the teachers and their experience with the ideas and teaching materials, so that the teachers have some ownership of it. As the principal said, "We can sit down and write a curricula [without the experience], and it doesn't mean a hoot..."

She continued, "The top down manager stuff, you can say all you want in terms of having the content and curriculum and everything else, but when the teacher goes into their room, the teacher does what they are going to do anyway. I would rather provide this in-service work to try to get teachers to do it on a voluntary level and with some excitement."

There are over 24 NDN programs present in the school. The principal said "NDN programs are developed by teachers in real schools, so there is validity there, from a school that's done it. That's one of the things we like about NDN programs." An NDN program may include curriculum materials and teacher training. The materials may take the form of activity books or handouts, textbooks, teachers guides, and scope and sequence.

In brief, the principal chooses programs to pilot at the school. The programs are revised by the teachers over a period of time . The school keeps what it wants from each program, making its activities and curriculum balance with the other programs' they have kept.

The principal explained this process. She said,

> *What typically happens here is that we look to the NDN and we bring in programs that seem to meet our needs and we piggyback programs that make sense together. We pilot them with a few teachers and then, if the program seems to be working, extend that program to other teachers. After the program has been in place anywhere from two to three years, we make a decision whether it should become a mandatory*

> *program, and then rewrite curriculum guides to reflect the inservice.*
>
> *It's sort of different than the way it normally happens. Typically, in other schools, it's like someone says 'Thou Shalt', the program comes in, you train the teachers, then they put the manuals away and do what they want to do anyway. Here, we bring a program in, it's voluntary, then bring it back in and see if we get more people to bite, bring it back in again. After it has been in place for 2-3 years teachers will make a determination, as a teacher committee, whether this should be left as a voluntary program or should there be aspects of it that are used. It's very rarely that we use the whole program. There will be aspects of the program that we will require.*

Using this process, she says "it took 6 years to get the language arts program to a level where I felt comfortable with it. Then a curriculum was written."

- **Textbooks have a powerful influence on curriculum, but Eastern is trying to resist this trend.**

The principal, as well as other teachers, are mistrustful of the textbook approach to science teaching. A number of points during our discussions came up about this, including teacher control and power, teacher knowing the information themselves, textbooks get in the way. Here are a few of their comments.

The principal said, "There is no formal science curriculum here. If you ask teachers if they had a science curriculum, either, A they would say 'no' or B they would say 'It's a textbook adoption'. I would be happier if they were saying 'no' because I don't want to just have a textbook adoption, it's only one tool. The majority of teachers, for science, still see the textbook as the curriculum. I see the things they have planned as moving them more toward an arbitrary approach."

But there is also pressure to have texts because of recently introduced standardized testing in elementary science. This approach is not without controversy. Some teachers support it, while others are wary. One teacher commented, "Right now there is a lot more pressure on us for state-wide testing. In the past, the kids might go a whole year without ever opening a science book." Another teacher said "I think an emphasis on testing will lead to textbooks, but at least the kids are getting some science."

This same teacher summed up a lot when she said,

> *First of all, there's a lot of control in having textbooks. It's very easy to use textbooks. When you take away the textbook you take away the control. And that's the biggest fear, not the hands-on activities. And that everyone isn't going to be sitting and quiet. That's really the biggest fear we've got to overcome. That's how we've been trained; we've been trained to control these kids. That's all part of teaching.*
>
> *This textbook is power. I have the power to say that all 27 children will be sitting, be quiet, and we're all going to read the same thing, and it's boring and they're going to hate that, and I know that, but I have the power to know that they'll be quiet. You take that book away from me and give them something to touch, they could start laughing, get excited, spill something on the floor. If you're not used to that happening in your classroom, no matter what it is, you're not going to give up the textbook."*

- **Open space creates a unique culture or behavior for the school and its programs.**

One of the conditions which helps facilitate communication between the teachers, and perhaps all the people is the physically open space of the school. As described earlier, many of the classrooms are in clusters and don't have full walls separating the space or sound from one room to another. The teachers, and the students, know what is going on in the rooms around them.

The principal remarked "It's always been a fairly traditional school. I think that because of the openness of the building it makes an open atmosphere. I agree with that. We would give our eye teeth to have the rooms with walls, but I'm not sure if we would be where we are today in that kind of atmosphere. It would take a whole different kind of support to make sure it happened.

She continued, "It's not uncommon to go into schools and to have the teacher across the hall not have any idea what's going on in that room. In this school almost everyone knows what everyone is doing. And they share. And I don't know how much of that is their personality, how much is the environment. I have a feeling it is a little bit of both, the environment facilitates that sharing. Children have to learn very early on to be respectful of each other. In this kind of environment you have to be quiet. It goes both ways though."

SCIENCE TEACHING, AND LIFE LAB

- **The school is making substantial efforts in their science curriculum development. Life Lab is part of this development, but is not the only science program with which they are working. Their goal is to develop a curriculum which is integrated, that has grade-specific content and activities.**

The process of curriculum development, described earlier, is being applied to their new science curriculum, of which Life Lab is a component. They are testing a variety of science programs, and taking the best from each approach to develop a science curriculum that is integrated, and that is appropriate for each grade level. At this time, Life Lab is mandatory at the third grade level, and is voluntary otherwise.

The principal described their recent efforts. She said, "The past two years we have been focusing on science. I'd say we are at an infancy stage in terms of looking at improving our science program. We've made several strides in the last two years, but we have along way to go. I wanted a good elementary science program, because our program needed improvement. It was totally textbook oriented, no formal training, not supporting change in science."

To meet this need, they have plans to try a variety of different NDN science programs, working to bring the appropriate concepts and activities into each grade level. Life Lab is only a part of this plan, rather than representing the whole program. Other programs they are working with include Starwalk, Hands-On Elementary Science (HOES) and Marine Science.

The principal explained, "We look for things that make sense in terms of what we already have in place, and how we can bring programs in that will fill gaps for us....Rather than going out there and looking at Life Lab and saying 'Will Life Lab will meet all of our science needs' we are looking at Life Lab and saying 'What science needs will it meet?' We've had our fourth grade teachers take the 'Hands-On Elementary Science' training to determine if it was worth bringing in. One of the things I liked about the program is the way that it piggybacks nicely with what we are doing. Third grade level is one of the levels we've targeted for the outdoor garden. HOES has developed part of their curriculum on plants. They have other aspects of science which I think would fill in nicely with gaps we felt with Life Lab. For second grade, HOES does insects. Our second grade teachers who have training in Life Lab are doing indoor gardens. One of their units is on insects."

The principal also cited other reasons why Life Lab is not their only choice for science. She said, "I don't see Life Lab as being our science curriculum. I don't think there is anything wrong with doing activities involving gardening at every grade level, but there is much more to science than just the study of plants. I would like to really focus it. I want to very much focus it at that third grade level. That's what HOES does, plants, it makes a nice tie-in. I'm seeing it's probably 5 or 6 years to developing a really good science curriculum. But I think that what you would see here is the intent of Life Lab, that it will be alive and well."

- **Many teachers need help and motivation for science teaching.**

The principal recognizes that there are a number of reasons why teachers haven't been teaching science. Several teachers acknowledged this also. The process of science curriculum development is also one of helping teachers become more familiar and comfortable with science and science teaching. Life Lab was cited as being especially important in this area.

One teacher, who was especially resistant to teaching science by his own account, cited how the gardening program has helped make science more accessible. He said "Science teaching has changed here in the last couple of years. In the past, teachers were bored with textbook science teaching. The teachers didn't feel competent. You needed to motivate the teachers as well as the students. . . When Grow Lab™ and Life Lab came in it made science more accessible."

Another teacher noted that gardening works well but you need help making it work. She said, "I think the biggest obstacle is the teachers' fear of failure, especially in a situation where you don't have people that have gardens. We did it all on our own last year, without the aid of the horticultural specialists. We got through it, but it's a relaxing feeling to have them to rely on. We now have someone who really knows what's going on."

Gardening, as science labs, present changes and challenges to traditional teaching methods. One teacher explained, "You've got to be relaxed with the fact that you are going to hand out shovels, rakes, and that the kids are doing things where they could possibly get hurt. For some teachers, they don't want to take chances."

- **Science teaching varies from teacher to teacher.**

We observed several different classes at various grade levels during our week-long visit at the school. Here are a couple examples of what teachers were doing to integrate Life Lab into their science teaching. These examples help illustrate what different approaches teachers may take to their science teaching.

In one fifth grade class several students were involved in their science projects. One was using a computer to play an ecology adventure game. Another was looking up information in an encyclopedia. Two other students were describing their recent experiments to one another. The teacher explained that her science program consists of several parts. These parts are 1) Mystery Scientists, where the students do research to discover that month's mystery scientist, then write a report on it, 2) monthly experiments and lab reports and presentations, of their own choosing, 3) science textbook reading assignments and worksheets, 4) Life Lab/Grow Lab™ activities, and 5) Voyage of the Mimi (an ecology adventure study). When we spoke with several students later in the day they spoke with enthusiasm about their class, and the science in particular.

In a third grade classroom, another teacher had a very different approach. This teacher explained that fitting in science was a challenge. "It's hard to get even 3 science classes a week", because of all the other subjects he must teach, he said. Despite this he tries to incorporate science into all subjects, recalling how it was when he learned best. "I do a lot of hands-on things because that's how I learned when I was young. Your hands remember. To motivate me I've got to use my hands." This is why he likes the Life Lab and Grow Lab™ activities, because they involve students and are hands-on. "People have different levels of engaging things. Hands-on activities can get them into it." In his classroom he has a Grow Lab™ filled with herbs and flowers. Students do art projects around the garden theme.

- **Eastern chose Life Lab because it exemplified the type of science program they want--integrated curriculum, cooperative learning, hands-on, accessible to teachers.**

There are a number of other reasons that the principal, teachers and students chose Life Lab. The principle reason was that Life Lab exemplified the type of program they want -- integrated, cooperative learning, hands-on, accessible to teachers. However, the initial experience to choose Life Lab came about through chemistry between the principal and one of the Life Lab program directors.

The principal said "I knew we needed something that was more hands-on. In knew we needed to improve the elementary science program as a whole. I really didn't care how we began. I went to a conference in Washington, I just wanted an NDN science program, I didn't care which one it was. The first person I met was from Life Lab. We hit it off. . . At the end of the workshop I was excited about what this might do for our school. But I didn't expect it before I had gone to this conference."

Now, the principal and others recognize how well the Life Lab gardening program fits in with their schools goals and programs. The principal said "One of the things that we liked about Life Lab is that it was integrated. It wasn't just looking at teaching science, it was also looking at math, language arts."

The Master Gardener, a principle volunteer with the gardening program said "Their awareness of their surroundings is heightened by the whole gardening program."

Teachers who are working with Life Lab discussed how Life Lab fits in with their classes. One teacher said "[Along with gardening] my kids do a lot of writing too. 3 days a week they go out and write about what is going on in the garden or the Grow Lab™."

Another teacher explained the diversity of her program. She said, "We don't have something regular like an hour a day [of LL]. I work it in all week; measuring activities, graphing, language and writing. Not every class participates, but everyone that does has their own garden plot. For my class, we had 3 raised beds. Last fall we really expanded the size of the garden; it's limitless cause there's a whole field out there."

- **Indoor Grow Labs complement the outdoor garden program and the Life Lab curriculum.**

One important feature of Life Lab at Eastern is how well the Grow Lab™ gardening carts are being used in combination with the Life Lab approach. (A Grow Lab™ is a cart (about 2'x4') that holds a large plastic tray for growing plants, and has a set of adjustable fluorescent light fixtures.) Grow Labs are in all the fourth grade classrooms. While third graders are required to study outdoor gardening, fourth graders learn indoor gardening, using the Grow Labs illuminated with artificial lighting.

A woman from Cooperative Extension noted how well these two programs worked together, and some changes that were in the air. "Life Lab actually helps teachers to integrate the garden program into their school curriculum, looking at science and nutrition. Grow Lab™ actually wants you to garden and doesn't help integrate it." The NGA is coming out with a curriculum for Grow Lab™ sometime this year.

- **The lessons from *The Growing Classroom* are not actively used in teaching.**

The Growing Classroom is supposed to be an important part of the Life Lab program. But the response from teachers on how this set of books was used was mixed. At Eastern, Book 1 (on how to start a garden) was very important for starting the garden. However, in general teachers have used only a few activities from Books 2 and 3.

One teacher said "When I reviewed the Life Lab books, the 'Getting Started' got me going, but only that. If I didn't have the horticulture background, I would be totally lost. The other two books gave me great extra science projects, but didn't get me out in the garden or Grow Lab™."

When asked "How many activities out of *The Growing Classroom* have you actually picked up and used, pretty much as it is?" the teachers responses were varied. One teacher said "Not much at all". Another teacher said "Ten activities. Those are more of the cooperative activities getting ready to go to the garden". A third teacher said "Three or four", and was followed by a teacher who added "About the same. I use it as a resource, see what they've got in there, and then adapt it myself. And now I do look at other gardening books. Now I'm willing to look."

One person commented:

> *The Growing Classroom is not lesson plans. It doesn't break down the subject enough in order to teach it. The lesson on compost is one example. In order to do this, you need to break the material in to a gallon size container rather than turn the kids loose in the field with a shovel and a rake. Use ordinary house refuse. Let them make a compost unit in a garbage bag, dump it once a week and see what's happening. The teaching outline has to ask the right kinds of questions. The questions aren't in here. This is helpful, but for an inexperienced teacher the material isn't there."*

- **Students are knowledgeable and enthusiastic about their science lessons.**

We spoke with several students about what they were doing and learning in their science classes. They described experiments and other activities, as well as expressing their enthusiasm for some of these projects. Several students mentioned activities that included math, reading and writing as part of their science activities. More than one student recognized the importance of the cooperative learning activities they were doing, saying they were "learning to cooperate" with one another.

One fifth grade student said, "I like science 'cause you learn things a lot and you get to do activities. Trying things, mixing things, and growing things. But I don't like getting messy."

Another student said, "We do activities all week. We do activities from the garden this week. Yesterday we had to figure out what kind of soil is in the pan. While one group was doing that, another group was listening to the Talking Flower tell about the different parts. We had to take it apart and put it together. One time we did an experiment of energy. We blew up a balloon and we tied it with string, and it would move along the string. We guessed how long it would take for it to go down the string."

Another student described an experiment they were doing on decomposition of objects in water. The students were asked to make a list of what things will change when you put them in water. The student said "We have something on the table; milk, a nail in water, pencils and rocks and stuff. You categorize, and [guess what will happen when you put it in water]. When they changed in the different stuff you write it down. I had a pencil. It might change if you sharpen it but it has to change while it's in there [the container of fluid] so I said it 'Won't change'."

We asked students what they are doing in the garden now. One student replied, "We've been planting things, and planted some bulbs up in the front. They'll come up in the spring. We planted some grass and it will become fertilizer. We're making compost piles, but it got out of hand."

One student said of his science class ,"I like the activities we are doing now, and also working in the book. Our teacher said science shouldn't be taught out of a book. It should be taught by doing experiments."

- **The garden offers students a sense of pride and ownership .**

Several teachers commented on how their students flourish in the garden, Even the "troublemakers" act responsibly in the garden, exhibiting leadership. Students take pride in their work, and are protective of the garden areas, their own beds as well as their fellow students beds.

One teacher said, "My kids will report people or problems they've seen in the garden. They feel like, 'It's mine and we're supposed to take care of it.' With many kids this has helped because these are the kids who would normally get into some type of destructive behavior. They were so proud of their garden that they were right there to protect it."

Another teacher added "Most kids I had out there, they were more excited about a green bean or carrot out there than they were about candy. . . We made salads. Some of these kids would normally turn their nose up at a radish, but because they grew that radish, it was delicious. They had a real pride in the fact that they were eating things that they had grown. Some of them would come on Saturdays to visit the garden."

One teacher said "The kids got very protective of each others plot, concerned about how they were all doing. That was a nice thing to see. I really thought they would say 'I planted this plant and everyone else's, so what' but they weren't like that."

Another teacher said "The low achievers can come in here and do great. . . It's a place where kids can really show their strength. You can have kids that you'd never expect."

- **Teachers feel a need for more horticulture education.**

A number of teachers mentioned that they needed more background in gardening. About half of the teachers we spoke with had their own gardens, but most felt there was a lot more they could know about plants and soil.

START-UP AND IMPLEMENTATION

- **The start-up effort for new programs requires a lot of work; funding, gardening, gardening expertise, planning, space, and a summer program.**

Start-up of new programs requires a lot of work. Money must be raised The garden must be dug and planted, and then the garden, as well as the program associated with it, must be maintained. As the principal said, "From enthusiasm to implementation is a whole other thing."

Funding for Life Lab has come from a variety of sources: District, School Improvement Funds, Title 2, grants, parent fund raising. The State of Massachusetts gave the school $15 for every student for special uses. Eastern used this money to pay for rototilling, put in waterlines, and buy other items. Title 2 money paid for the last teacher training at Eastern.

An initial grant for tools and supplies for the garden was essential for getting the program going, and getting support from the district and other funding. The principal said "We wrote a grant [to the National Gardening Association] and received $600 worth of tools and supplies, which provided us with a great start-up. It would have been hard to sell [the Life Lab program] to the district or whoever to get money for tools; not textbooks, but tools."

- **One of the key factors in the program's start-up was the Life Lab teacher training and the follow-up at the school.**

Everyone spoke highly of the 2-day workshop they attended, and also said how much work it is trying to get the program going back at their school. The principal spoke very highly of the Life Lab training. "If you are trying to get this started in a public school system, I would go with Life Lab training. Absolutely....In the training they get people enthusiastic about it. It's an excellent 2 days that make you want to get in there and start."

But enthusiasm does not solely a program make. Time, money, and planning are necessary to make the program happen. The principal said, "I think what's critical is that you recognize that if you go to a good training it still requires a lot of change. It's not the kind of thing you can send teachers to and think that the next day they are going to be in there and be able to use it. . . We were frustrated here in the beginning waiting for pots because we didn't have the money in the fall. Obviously next year, we can get more regular financing. You have to think through all the possible costs for this program and how you are going to get all the supplies for the teachers."

The principal recommended piloting a new program before you make a substantial investment in it. She cautioned "You also may want to [train] a small group of people who are willing to pilot the program first for a year. We took three teachers who had the training initially. That way, if it's not going to work in that school, you are not spending a lot of money on training a big group. If it seems like it will work with a pilot group, then bring the training back in."

One teacher suggested that spring is the best time for teacher training. She said "If it's possible, do the training right before you actually do the garden. We had our training in October and had to wait until the Spring. The anxiety [about making the garden] built and built."

- **Once the garden is established, managing the garden and Life Lab requires additional staffing in the garden area, or help with Life Lab activities.**

Eastern was relying more and more on the efforts of their volunteers to maintain their garden and the Life Lab program. The principal said "We are trying to get volunteers in, especially during lunch and recess time. One of the problems last year was 30 people gardening at one time. If you get volunteers coming on different days you can have the teachers doing one thing with a group of students and others in the garden."

A teacher added "In the garden, 10 kids per bed is maximum. The other kids end up waiting. Through this whole thing they have to be cooperative. If there were another person helping, we could do more hands-on activities, cooperating with each other. You know kids are going to screw around, hit in the face with a hoe, that kind of thing. It's going to happen, so with another person it would help a lot."

Another teacher spoke of the challenge of managing her students' enthusiasm indoors. "I have 31 kids in my class, and I find it very frustrating. I like to do a lot of hands-on activities. I don't have walls, and they get excited. The noise, the kids are really excited, and then I know I am bothering the class next door, and about 4 other teachers around me. I am always squelching all that natural enthusiasm. That's what I find frustrating. Even if there were another adult there with me, I don't know if in a classroom area it would help."

One teacher described what would be an ideal volunteer situation for her class. "Ideally I would like to have a volunteer in the building with children that weren't in the garden, and a volunteer out in the garden with me working. I think if we can get one, I would like to have the volunteer in the building teaching language or something, and I would take a small group out, then send them back every 30 minutes and get another group of kids. So within an hour and 15 minutes or so, they would get in their science and maybe a language."

Another feature of the garden was a recently acquired janitor's closet that was being used as a garden resource center. This was the first space in the school shown to us during our visit, and a number of teachers mentioned it as an important addition to their program. The closet was small, but it gave them a place to prepare plantings, store tools, and display educational materials for teachers. It was a center within in the school. The master gardener said "It's important to have a center, even if it's just the closet."

- **Summer garden.**

A final concern related to the start-up and maintenance of the program is how will the garden be maintained over the summer. They hoped to have volunteers come in during the summer and take care of the garden. One teacher suggested she might be available to work with student volunteers over the summer, and another spoke tentatively about starting a summer gardening program. But at this time they had not resolved this issue.

- **The garden is place for both teachers as well as students to learn and experiment.**

One teacher said "When we started last spring, I'm out there by myself in the corner with my rake and shovel, and I'm having a great time. I enjoyed it."

One teacher felt like *The Growing Classroom* helped her bring garden activities into her class. "We needed the directions of how to do it with kids, rather than how to do it by yourself."

One of the visitors to the school commented on his experience in his town. he said "In an inner city situation, you get a broad perspective of ideas. Kids might know stuff teachers don't know. . . Just let the kids experiment and see what results they get. Even if they plant their bulb upside down."

Another teacher briefly described her class' experience planting flower bulbs. "We planted flowers for beautifying the front office. We read the p-ackage. We did a few wrong and had to dig them up."

- **Wanted: grade-specific lessons.**

One of the weaknesses of *The Growing Classroom* at Eastern is that the lessons and activities are not grade-specific. The principal cited her experience with HOES, how well they combined grade level activities and learning processes. She said, "At first grade level they try to show all of the lessons as 'observations'. second grade level it's 'classification'. third grade is 'experimentation'. fourth grade is 'analysis'. sixth grade is 'application'."

About *The Growing Classroom* she said, "My sense is that no one is using it. They've been using the gardening unit. What I've heard is that they need grade-level activities. They want something set up that says 'first grade, second grade, etc'. And I know that's what the Life Lab folks are working on with Addison Wesley."

On the other hand, *The Growing Classroom* does provide the ideas that helps keep the teachers moving ahead with the garden and science. The principal said, "It's like that gentle prodding in terms of what grades will accept. Once now through Life Lab we have things to do besides show them pictures, volunteers to help so the materials are there so you don't go searching for things. We've also got volunteers to do some lessons."

This process of curriculum development is not perfect. It has to go on over time during the normal school year. One of the effects it has is on repeating curriculum. The principal wonders where the Life Lab materials or activities will fit into the process. She said, "The other thing that worries me, I know it's our first year, but I see everyone doing the same thing in all the rooms so I'm wondering 'What's going to happen next year?' It's fine for the first year to let people do what they want to do and get comfortable, but at some point you have to get pretty formal and say 'These are the activities' by grade level."

- **Two Volunteers are playing an increasingly active and important role in the garden and Life Lab-like activities.**

The principal explained that the PTA was involved with the gardening program. "Our PTA is trying to set up a nature trail. We had one years ago, but it got overgrown. Again, I see the garden helps create an interest in the outdoors in general" The PTA was also involved in raising money for the purchase of the school's Grow Labs and some other supplies needed for gardening.

There are two main volunteers involved with the garden, the Cooperative Extension Agent (CEA), and the Master Gardener, affiliated with Cooperative Extension. The CEA has tried to gather resources for the school, and also get the school involved in the broader community. She said she is out trying to get free resources for the school's program, but "In Eastern we don't even have a garden center or hardware store."

However, her recent involvement in another project was a great success. This year the school's participated in the Worchester Flower and Garden Show. The students and teachers prepared a display, which included photographs of their school's gardening program, A Grow Lab™ with students' stories and artwork. Their exhibit won second place. Nearly 200 students and teachers, about 25% of the school, attended the Flower Show.

We asked a teacher what their connection was to this show. She explained that they knew they were encouraged to participate by the CEA. "We got two hundred passes to the show!" she said. "The Cooperative

Extension Agent introduced the idea of our participating. We had a meeting and decided we wanted to do it, and the teachers picked up on it."

The other main volunteer in the gardening program is the Master Gardener. An elementary teacher herself (but not a paid teacher at Eastern), she has been trained by the Cooperative Extension as a gardening specialist. In exchange for her training she does volunteer work. She chose to work at Eastern because she lives in that community and her daughter is at the school.

The master gardener has been a volunteer at the school only a few months, for one or two days a week, although she is only supposed to be there half a day a week. Among her activities, she is teaching classes, training teachers, and developing educational materials. The interesting thing is that until our visit she had not used or even reviewed any of the prepared Life Lab materials from *The Growing Classroom* to develop any of her lessons, or her overall program. She has been developing materials herself.

The master gardener discussed what her role in the program was. "I want the kids to see the total involvement of science in their lives. I want them to appreciate plants, how much they are dependent on them. You know, you can learn so much about the world working in the garden. . . These kids are starting to realize that the plants and the garden have a lot to do with other things."

In regards to the curriculum she added "The teachers are not going by any curriculum. They want ideas and then they are off and running. . . Even after the teachers have the knowledge to keep it going it is still important to keep the gardener involved in the program."

The principal said "She really helps keep the teachers going."

DISCUSSION

Eastern Elementary is a remarkable school because of its relative autonomy in terms of curriculum requirements, and the creative process of curriculum development directed by the principal. Life Lab is an ideal program for Eastern because it shares so many common goals, regarding science education and educational processes. And Eastern has made significant progress toward implementing Life Lab in a very short time; it has a large outdoor garden and a large indoor garden program, it has one or two key volunteers to help with the gardening program, it has received support from a variety of groups, the principal has mandated Life Lab in third grade.

However, how much of what Eastern is doing, and where they are going, is really drawn from Life Lab? Certainly the inspiration for a successful garden-based science program came from Life Lab. And the start-up of the garden and a basic set of lessons have been drawn from *The Growing Classroom*. But it is unclear, once the garden is going, how much of *The Growing Classroom*

will be used. If the Master Gardener continues to play a significant role in managing the garden and teaching classes, she may establish more of her own character for the program than Life Lab's. And teachers expressed very mixed reviews as to how useful *The Growing Classroom* is once the garden is underway.

The question of "Is it science or is it gardening?" is difficult to answer. In this case, we observed teachers who were emphasizing science process skills (such as observation and analysis). The principal is trying to develop a curriculum that focuses on these skills according to the cognitive learning abilities of the students, by grade level. We observed science lessons, and heard about lessons, in which students were encouraged to make guesses, hypothesis, or develop theories about particular experiences or events. All these observations tend to support a science emphasis. But few of these observations come from experiences around Life Lab or the garden. To answer this question would involve more study at this school.

Eastern would probably be an ideal site for the Life Lab Science Program to field test the latest version of their curriculum, the textbook that will be published by Addison-Wesley in 1992. This will give Life Lab an opportunity to continue to influence Eastern's curriculum development, before their cycle of curriculum development in science has passed.

INTRODUCTION TO THE WASHINGTON D.C. PUBLIC SCHOOLS AND SITE VISITS

> *I think it's something that we really rob our kids of if we don't give them a chance to really learn science, about their environment, and stop thinking of science as something in a little lab somewhere with a white coat and all that junk.*
>
> *D.C. Public Schools Administrator*

This section introduces the general educational issues and science programs of the Washington D.C. Public School system (D.C.P.S.). The purpose is to present the general ideas which may be common to all D.C. schools, as well as point out particulars of the District science programs and Life Lab. The information in this section is based primarily on 3 school documents ("Hands-On Mathematics and Science. First Report of the Mathematics/ Science Initiative", "A Preliminary Evaluation of Pilot Programs Resulting From the Math/Science Initiative", "Welcome to Our Schools District of Columbia Public Schools") and interviews with the coordinator of the Math-Science Initiative.

Three site visits were conducted from Feb 21-24, 1989 at three elementary schools: Alexander, Barney and Carson. The weather in Washington D.C. at this time of year was cold, with snow on some days and rain on others. February is Black History Month, and all the schools we visited prominently displayed pictures, stories, and posters of important people in Black History, in the hallways and in classrooms. Many of these displays included students and teachers work.

SUMMARY STATEMENT

Washington D.C. is a community of powerful contrasts, between wealth and poverty, Blacks and Whites. The D.C. Public Schools have a standard curriculum that all schools must use, relying on clearly stated objectives and outcomes. Recently, the school District has begun introducing special programs that emphasize math and science, and generating student interest in these subject areas. Life Lab is one of these programs, and has been in the District less than two years. In this short time, Life Lab has received a very positive response from the program implementers and users, and proven to be compatible with the existing curriculum. However, there is a need for an assessment instrument, to assess how much science is being taught and learned.

- **Washington D.C.--a community of poverty and power**

Our nation's capital is a community of powerful contrasts. Foremost is the contrast between the affluence, traditions, and wealth of the government circles, and the poverty of the urban areas that surround these circles. Within a few blocks you can pass through a neighborhood of gutted buildings and trash-covered streets, and a neighborhood of expensive hotels, restaurants, and embassies. The lines between these neighborhoods may be as little as one block, or across a busy thoroughfare. Travelling on a municipal bus from one section to another, you can observe a change in the racial make-up of the population, from Black to White, or reverse if you are going the other direction. Seventy-one percent of the District's citizens are Black.

D.C. has one of the highest crime rates in the nation. On a cold day in late February a TV newscaster commented that 83 people had been murdered in D.C. since the first of the year. I shuddered at this news, and felt the tension on the streets as I moved from one neighborhood to another visiting the schools.

It is against this background of contrasts, of power and poverty, legislation and violence, that the D.C. public schools must try and educate over 100,000 elementary school students.

- **D.C.P.S. Curriculum and Science Education**

The D.C.P.S. has been undergoing an administrative reorganization the past few months, and was in the middle of this effort during our visit. The reorganization has come about through changes in policy affected by the new district Superintendent. While the reorganization was obviously shuffling staff and space around D.C., it seems to have little impact on the current curriculum or science programs.

The District motto is "Keys to educational success: Accountability, Efficiency, Effectiveness". There are two main sets of guidelines to curriculum and instruction in the D.C. public school (D.C.P.S.); the Competency-Based Curriculum and Student Progress Plan.

The Competency-Based Curriculum (CBC) is the principle guide for teaching. It is a set of thick notebooks, presenting and an objectives-based curriculum, and including a few examples or sample lessons and activities for each content area. For science, it consists of approximately 600-800 pages of guidelines. As stated in "Welcome to our school", "The basis of the instructional program for students is the Competency-Based Curriculum. The curriculum focuses on instructional goals for grades pre-kindergarten through 12. The school system measures student achievement by using criterion-referenced, norm-referenced, and teacher-made tests." At every school we visited, teachers and administrators cited the key role that the CBC plays in instruction at their school.

The other component of this curriculum is the Student Progress Plan (SPP). "The Student Progress Plan is an integral component of the CBC. The plan, for grades 1-6, reflects the school system's commitment to ensuring that all students master essential skills in reading and mathematics. . . Promotion is based on successful mastery of these skills; students not ready for advancing receive additional assistance in learning the necessary skills."

In the area of science education, most elementary schools in D.C. have their own Science Resource Teacher. Theoretically this teacher spends about 50 minutes a week in each classroom in their school teaching science, or brings the students into the science lab (if the school has one). Two of the three schools we visited had a science resource teacher, and science lab.

One of the drawbacks to this approach is that the classroom teacher may not be part of the instruction. As explained by one administrator, "The teacher uses that period as a planning period, so the teacher may or may not stay during the instruction. We're not happy with it."

- **"We're trying to get our students interested in science"**

Over the past several years the District has seen the need to improve the quality of science education. On this behalf they created the Math Science Initiative (MSI) and placed it among the top priorities for school year 1988-89. As stated in the First report of the Math/Science Initiative, "The purpose of the MSI is to support and enhance the existing math and science programs by providing programs that will enrich students' experiences and increase students' interest in learning math and science." The theme of the MSI is "Bringing the world into the classroom and taking classes into the world to learn mathematics and science." [Hands-On Mathematics and Science. First report of the Math/Science Initiative. May 1988]

The MSI is being coordinated by Dr. Alice Hartnell. Dr. Hartnell explained that there is a need for a new emphasis on science education because "nationally, minorities are not going in to science or math." She cited student choices in the sciences and test scores as primary indicators of this decline. She said "You probably area aware of studies that show that minority students are not studying science, and as a result a very small percentage of minority are getting masters or doctoral degrees in science. It's on a decline."

She continued, "Science is going dead, that's my assessment of it. Indicators are these: fewer students taking science in high school, fewer chemistry and physics students. People are taking biology because it's a requirement to take one lab science. If there were great interest then they would take these other sciences."

She said, "Another indicator is performance on tests in science. It is very low in elementary school. That says to me that the students are not interested. If you don't do something to get them interested, and keep them interested, right on through the elementary school so that when they get to Junior High they are still interested, you're going to continue to lose students."

Dr. Hartnell elaborated on these goals citing student interest, test scores, career awareness, and other issues as their primary goals. She said "My job entails bringing into the school system new and exciting programs in mathematics and science to get more students interested in studying and learning math and science." She listed other goals, including: 1) to increase achievement on various standardized tests, comprehensive tests of basic skills, SAT, PSAT, especially in the areas of math and science; 2) to help students become aware of careers available to them in math and science; 3) to involve the communities and the area's universities and colleges in helping with students, by being mentors, volunteers, participating in various programs, and helping propose innovative programs; 4) staff development.

- **Hands-on science experiences are at the top of the list**

Hands-on science and experiential learning are an important part of this new science emphasis. The MSI introduced four pilot programs in math and science into the D.C.P.S. in 1987-88. All four of these program rely on some type of hands-on approach. These programs were:

1) Critical Thinking and Strategic Reasoning Skills Development
2) Hands-On Elementary Science
3) Life Lab Science Program
4) Stones and Bones

A preliminary evaluation of these pilot programs in August 1988 [A Preliminary Evaluation of Pilot Programs Resulting from the Math/Science Initiative. August 1988] revealed:

1) "Students were generally pleased with their experiences and teachers were positive about most aspects of the programs."

2) Teachers desired more time to conduct the program, and better access to more materials

3) Approximately 10,000 students and 111 teachers were impacted by the implementation.

The D.C.P.S. became involved with Life Lab through the State Facilitator Awareness Programs in science two years ago. As follow-up to this awareness session, Dr. Hartnell and the State Facilitator sent letters to teachers to see who would want to try a new science program. Life Lab was selected by a number of teachers who responded.

- **Elaboration of goals for science education**

In discussing their goals for science education and the results of pilot programs Dr. Hartnell emphasized three main points: to get the students interested in science, to help prepare the regular classroom teacher for doing science (rather than a science specialist), and to have the principal demonstrate commitment to the science program.

She repeatedly commented on the importance of generating student interest in science. She said "I think it's something that we really rob our kids of if we don't give them a chance to really learn science, about their environment, and stop thinking of science as something in a little lab somewhere with a white coat and all that junk. It's right around you, and become aware that it is."

She continued, "My great interest is to try and get students interested, because if they learn something in science then they can decide later, and go into other areas....As long as you have something motivating the kids to do science, that's what matters."

She continued, "What is happening is a lot of the teachers who are not science teachers are feeling more comfortable as they go through training. They are teaching science! At some schools the principal requires that every teacher teach science, whether they've had all this training or not. I think it's much better when they've had some training in a particular program and they can integrate it into the science programs."

She emphasized that programs be easily integrated into other existing programs or approaches at the school. She said "We are not interested in a program that is taught in isolation. If they are doing something in the schools we encourage them to incorporate this program into it. A good example of this is Alexander Elementary. They were already involved in a program of growing things. . . When we came in with Life Lab science they integrated all of it into one big science program, a butterfly garden. . . We thought this was a beautiful way to bring this all together, integrate the school program with Life Lab."

In regards to getting the principal's commitment for a science program, she explained that they built this type of screen into their piloting process. Previously teachers had volunteered for training then tried to convince their principal of the program. But this wasn't as effective. "We decided to install a new process", she explained. "Instead of just having the teachers go back to the schools and the principals send back a note, we decided we would bring the principals together because we found out that those schools in which the principal was involved before, during and after the training, were the schools where the program was implemented best. We brought the principals in, gave them an awareness presentation, told them what the program entailed. . . If the principal didn't come to the meeting and they didn't send a representative, we did not encourage them to be involved. This was great, because the principals who came are the principals who are involved now."

To help more teachers teach science the District has relied on National Diffusion Network (NDN) programs, but they are trying to implement their own teacher-training model. Their experience so far has been very successful. She said "What we are trying to move toward is to have regular classroom teachers learn how to teach science. The Math/Science Initiative is trying to bring in science programs that have a training element so the classroom teachers can begin to diffuse science lessons into their regular teaching, and therefore will be more responsible for the science program. In the mean time, we can look at NDN programs, programs that work in science and allow teachers to participate in training in those programs and teach lessons from those programs right along with the science."

Dr. Hartnell expressed her concern that "too much of science is taught from textbooks". As an illustration to this point, she described an activity she observed in a class where the students were drawing a picture of a plant and labeling the parts, by copying the picture from the textbook. She noticed that on the windowsill of the classroom there were a number of live plants. "Why don't they use the real plants as models for drawing their pictures, instead of the textbook?", she remarked. Another example of the misuse of textbooks is outlining chapters. This is not the way to learn science she says.

But she saw that Life Lab was different, and spoke enthusiastically about its prospects in the district. She said "I like Life Lab because it gets more students interested in science. It has a new approach. . . We want Life Lab science. We want it to grow in the schools, want more schools to have it. We want it to expand....Right now we are building a baseline of data and groundwork from their experience with these programs, to show that this can work in an urban school."

- **Life Lab has been well-received**

Life Lab has been well-received for a number of reasons, including excellent training, people are enthusiastic, curriculum meets goals and needs of the MSI. Dr. Hartnell discussed these points.

She explained that the students response has been very positive. She said, "We have just been amazed at the response of the students involved. They enjoy the activities so much. We are thrilled about Life Lab."

She feels that Life Lab helps bring science to the students' attention. She said "Many of the kids never see a garden, never see where food comes from. They never really see things grow. Or if they see them they're not brought to their attention. They don't notice that the things in their environment are important and a part of learning science. They've seen flowers and plants growing but they haven't really paid enough attention to them to study them or to know much about them."

She also is impressed at how well Life Lab gets the teachers involved. She cited the Life Lab training workshop as being exemplary of this philosophy. She offered a story of her experience at a Life Lab training. "I'll always remember the first day of training for Life Lab," she said. " The teachers came in to the staff development session. They came in and sat down and they were ready for another one of those two days of routine mundane stuff. And the expressions on their face when the workshop leader walked in and said 'Okay, everybody up'. And they were up from that moment to the end of the workshop, almost. It's that kind of thing that got the teachers involved. From the evaluation they did I see they thought the workshop was excellent."

She also acknowledged that Life Lab takes more of an investment of time and resources than other science. She said, "I can see us having a coordinator just for Life Lab"

Dr. Hartnell commented on the quality and usefulness of the Life Lab curriculum. She said that the lessons are well-written, and exciting for students. "They work. Teachers can take them out of the book and use them." The only thing she suggested should be added to the curriculum is a pre- and post- assessment.

- **Integrating Life Lab into the CBC and the school programs**

Dr. Hartnell discussed some of her experiences and hopes for Life Lab in the schools. She addressed the development of a curriculum guide, integrated lessons, and creating gardens.

In terms of a curriculum guide, she said "One of the things we had planned to do was bring in Life Lab teachers and develop a guide for incorporating Life Lab curriculum into our regular science curriculum. I still look forward to doing it. It's just a guide that says 'When you are teaching

Objective so-and-so, bring in lesson so-and-so. It could eventually be incorporated into the [CBC] so that it is not a separate booklet or piece of paper."

She gave a number of examples of how Life Lab lends itself to an integrated, interdisciplinary approach. She told a story about one teacher who has redesigned her classroom so that it is all Life Lab science. She said "the teacher calls it the 'Official classroom for Life Lab science'. She incorporates spelling, reading, everything around science. I visited her class, and talked with students. They told me about nutrition and things they liked most about Life Lab science, and how they tell their parents about not eating certain foods. They were really into it. They had all kinds of plants they had grown around the room. They had written a lot, too."

Dr. Hartnell did not think that all the schools with Life Lab would have gardens, but she did expect some type of planters, indoor or out. She said "I don't think all the schools will have gardens. There are limitations on the commitment the Science Resource Teacher can make. They do a lot of indoor planting ,though."

- **Recommendation for an assessment instrument**

Dr. Hartnell said that she would like to have some type of assessment instrument, to measure how much science was being taught and learned. She said "I think there is enough science, but it's all what I think. That's one reason I'd like to have some kind of assessment, some kind of instrument that would be administered at the beginning and end of the program, and some kind of measure of what science has been taught, and what specifically from Life Lab did they really learn. . . We think they are learning a lot, but we want some way to document that they are."

ALEXANDER ELEMENTARY SCHOOL, WASHINGTON D.C.

> *Children don't see a lot of flowers or beauty around where they live. . . What do children think of when you say to them 'flowers'?"*
> *Principal, Alexander Elementary*

> *You know, elementary teachers are pretty much like the children that they teach. Once you get them excited about something, they're non-stop. The problem is getting them excited.*
> *Teacher, Alexander Elementary*

This report presents a case study of the Life Lab Science Program at Alexander Elementary School in Washington D.C. Dr. Mark St. John and I visited Alexander for one day (February 24, 1989) during a week-long visit of schools in Washington. During our visit we talked with teachers and administrators. (Additional information on the D.C. Public Schools educational and science programs can be found in previous sections of the larger report.) This report is organized around the following subject headings: Summary Statement, School and Community, School Leadership and Curriculum, Science Teaching and Life Lab, Start-up and Implementation, and Discussion.

SUMMARY STATEMENT

Alexander serves an impoverished transient population in the inner-city of Washington D.C. The student body, primarily Black, is made up of children from the immediate neighborhood, and those bussed in from the nearby air force base. There is a strong emphasis on teaching reading, writing and math, driven in part by the need to do well on District tests. Science education is of growing importance at the school. There is a Science Resource Teacher who is responsible for the science programs, including Life Lab. The school already has a garden, which has become an important part of the school's identity. Life Lab complements this existing science program, and students flourish in the garden environment. The school hopes to establish a summer gardening program. The lack of money for this and other science programs is seen as a major obstacle toward enhancing the quality of science education at Alexander.

THE SCHOOL AND COMMUNITY

Alexander Elementary School is located in the SE section of Washington D.C., not far from Carson Elementary. The neighborhood is one of low income housing, primarily a Black community. The school's secretary described the socio-economic mix of their school and community. She said "A lot of our children are from welfare recipients families, and live in low-income housing. Not all of them are Black, but the majority. Most of the students from Bolling AFB are White. We are a totally integrated school while the building itself is in a total Black community.

The student body is racially mixed, with 60-70% of the students Black, and the rest are White, Asian, and Hispanic. Because of the transient nature of the military families, as well as the poverty in the neighborhood, there is a high turnover rate at the school; something like 200 new students a year, out of a total student body of 600. This changes from year to year. The teaching staff racial make-up is similar to the student body. Classroom size is about 20 students per class.

Academically, there is a strong emphasis on reading, writing, and science at Alexander. The school has several innovative programs, including IBM's "Writing to Read", three computer labs, and a large outdoor flower garden. This garden, known as the Butterfly garden, is the centerpiece of a school-wide celebration in the spring, where students release the butterflies they have grown in their classes (more on this later). There is a Science Resource Teacher (SRT), science room, and they participate in the city-wide Science Fair each year. The SRT teaches lessons in all of the classrooms each week, and manages special projects such as the science fair and the garden.

SCHOOL LEADERSHIP AND CURRICULUM

- **Curriculum, philosophy, and practice are shaped by the needs of the student population, and the school's community**

Given the amount of poverty, broken homes, single parent families and drugs in the community, it is very understandable when the principal says "Our outlook is to provide a haven for all the children in the community."

The principal expressed her concern for the children, growing up amid such harsh urban conditions. She said, "We care about all the children. We try to make it very personal for them, their problems that they bring, that we don't see as so unusual that they can't be resolved. You know there's poverty, growing up in homes with single parents, crime, drugs. But the children have lots of potential and lots of hope, and if you can garner that, and help our staff people to not be overburdened, overrun, then we can do many things."

She talked about the challenges of the urban schools, to help children achieve academically as well as personally. She said "The urban schools have a long way to go in getting the results that we seek. We have so much more to deal with, from the beginning. . . .We want to use every resource we possibly can, and help promote getting better test results, good attendance, children feeling good about themselves."

- **There is an emphasis on reading, writing, and math at the core of their curriculum. Science is becoming more of a priority.**

The principal discussed the importance of both reading and math in the curriculum. Students' performance on tests play a large role in this emphasis. The principal said "Reading and math are the two things that we promote the most. And they are all that we can cover with our budgets, from our schools systems. . . We see that you must focus on them. The children in large urban areas get low test scores, so you try to shore up from so many different ways."

She added "I tell my staff it's Reading, Instruction, Word Perception and Comprehension. It's because when the test scores are not at that target, then you try to get all these other kids up."

The principal is trying to bring more science into the curriculum. But she has found that budget priorities in the District restrict this. She said, "We talk a good game about wanting science to be in the forefront of curriculum, because we realize the impact that it has for our country. But reading and math [come first.]"

- **The principal is committed to encouraging and providing science education; emphasizing experiences more than content.**

The principal plays a leadership role in fostering science education in the school in a variety of ways. She believes that science education is important, that students need both science process skills and content, and that teachers need to be retrained to become better science teachers.

The principal feels that the methods of teaching science that involve hands-on activities and cooperative learning help meet the school's objectives of fostering independent self-directed learners. She said "The reason why students are not more interested in things as they go along is because everything is so repetitive, and so ordinary. . . They know you are going to say 'Open your book to page such and such. Read this and get an answer.'; not 'What do you think about this? How could there be another answer? Everybody has an answer. Give an answer. Think of some solution'" With the other [approach] they could come up with wonderful answers and thoughts. It helps them be self-directed, confident."

When asked what was more important, the learning of science skills or the content, the principal said that "a combination would be best." She recognized that many teachers are poorly prepared to teach the process skills. She said "I personally and preferably go with the [science process skills]. I've seen it work. The children come out brighter, more independent, can go much further. However, the reality of it is is that we [emphasize content]. We are so used to our selves, from our own school experiences, thinking that the few facts you can recall are so important."

- **The principal's goal is to have all the teachers doing science, not just the Science Resource Teacher (SRT).**

While the SRT is responsible for weekly science lessons in all classes and some special projects, the principal encourages all teachers to be involved in teaching science, with the help of the SRT.

The principal said "Without the SRT we would have a lot less science. . . .We are telling the teachers in every grade 'You must teach science. The once-a-week class that your pupils get from the science teacher will not be enough.'"

Several teachers acknowledged the emphasis the principal placed on their teaching science. One teacher said "I think that from my conference with the principal, she thinks science is a real priority; math, reading and science. She'll ask you outright 'Are you teaching science?'"

Another teacher explained how the principal had influenced her teaching. She said "Through the principal's emphasis, I'm becoming more interested in teaching science. It helps my children to be exposed to it more than once a week. I can see to it that they stay on top of science more than the SRT can, in that they don't feel as responsible to her as they do to me. They will study if they know they are going to have it more than once a week."

- **Improving science teaching is a challenge.**

In a school system that so heavily emphasizes learning objectives and testing, it can be difficult to fit in science lessons regularly. Teachers and administrators also have a fear of learning science that must be overcome if science programs are to be encouraged.

The principal pointed out that there is considerable pressure from the District to do so many other things in the classroom. She said "We are test oriented. We are timed. We are under so much pressure for time. We are doing a million things, literally. . . Our system [DCPS] has said 'Teach science more' but they haven't given us the wherewithal to do it."

The SRT talked about why she felt science was neglected in elementary schools. She described a cycle that centered around a fear of learning science, that extended throughout the school system. She explained "At the elementary level teachers are not scientifically oriented to begin with, because elementary curriculum is more or less a general education. The teacher is supposed to teach all areas. Science is always something that's hard or difficult, that's the idea. So the teachers tend to stay away from what they are afraid of. On the other hand you had the administrators who were growing up from that same mind set. So , are they going to push science in the elementary schools? It becomes a vicious cycle. Once in awhile you may find a principal who is interested and will push science. And everybody will get busy and do it."

One teacher talked about his strategy for making sure that science doesn't get excluded. He has done this by incorporating science lessons in with the other subjects. He explained, "Because of the emphasis on reading and math, most of the science we do is usually squeezed into the last thirty minutes of the day. If there is some time left you can get to the science. I've changed my strategy. This year my students are strong with reading and can handle the science textbooks. I am teaching a lesson or hour of science a day. I have to incorporate a whole different set of objectives with the science. It must be part of the reading class, otherwise there wouldn't be time for it. Instead of doing a story or whatever, I'll do the same thing with a science book, and pick out key phrases, and work on reading skills. We do it with math too, basically with measurement. I also use the social studies book a great deal the same way." He concluded, "If you wait to teach science, time runs out."

SCIENCE TEACHING AND LIFE LAB

- **The overall science curriculum is centered around the Competency Based Curriculum (CBC), but each teacher brings their own initiative and approach to the learning objectives. The school's science program is coordinated by the Science Resource Teacher.**

The SRT explained that she uses the CBC as a guide, but develops her own programs for teaching science. She displayed the science component of the CBC; two very large notebooks with over 600 pages. She explained, "[The CBC] lays out what should be taught grade by grade. It's exactly as it says, a guide. It's not a hard and fast thing you have to follow. That's why I have elected to use textbooks to support and to branch out. That's what gives me the leeway to bring in all of these other creative things."

She said that in her science lessons she is trying to emphasize skills, rather than content. She said "We basically are teaching skills: observing, predicting, measuring, and the like. Whatever I can use to teach those skills, I'll use it. Everybody needs those skills. It's not the content as much. For example, the Butterflies [referring to the extensive lessons she does on butterflies] came out in third grade because we had to observe an organism, and be able to predict an outcome. That was the skill or the objective."

She said the Holt Science series fits in well with the CBC, and even seems geared to the CBC. "It is written in an enjoyable style for the children" she said. She is pushing for textbooks for the whole school. The District does not really push textbooks, but she feels that the District should have a more unified approach on textbooks. At Alexander, only the fifth and sixth grades have textbooks.

The SRT helps teachers use the CBC. At the beginning of the year she will lead a workshop on the curriculum and new materials. Then throughout the year she will reinforce this through individual meetings with teachers.

One teacher discussed his view of the CBC, and how that effects his curriculum. He said "I get my ideas from [the CBC] and expand on it in many, many different directions. . . .With the CBC, they just give you the basic objectives. You have to decide what direction to go into, to get the children's interest."

- **Teachers feel that hands-on science and an integrated curriculum create better learning environments.**

When asked "Which is more important--science for exploring and inquiry, or science for facts and basics?", teachers responses were varied. One teacher said "Hands-on for me. I feel our children learn better by doing, being and working with things." Another teacher added "I think that hands-on would inspire learning better, and would further encourage inquiring minds."

Another teacher agreed with this, but also spoke to the need for content as well as inquiry. He said "I don't think you can really be effective with only one or the other. If you don't have this set of facts, they won't know the questions to ask about this type of material. This morning [in our lesson on roots], if the children didn't know the terms "root cap", "root tip", "root hairs", they wouldn't have any idea of what kinds of questions to ask or what to look for. You've got to have both. You've got to touch the roots, see the roots, but you also have to see the terms."

Another teacher spoke about the importance of teaching science in the context of other subjects. She said "In all teaching on the elementary level nothing should be taught in isolation. Everything can be taught together. When skills are taught in isolation, there can be no connection. Children do not realize today that when you write a sentence or paper in science, you have to employ the same skills as when you are writing for language. The same reading you do in the Basal reader you have to be able to transfer those skills to geography, science, and even math. They don't realize that when they are reading a number sentence that this too is reading. You put it in words."

The SRT also supported the integrated approach. She said "If it's integrated it seems more alive. . . I try to draw from as many sources as I can to keep them interested. How we tie in, like with Greek myths, to develop their writing skills. We read stories of Greek myths then they have to reconstruct their own, a different one, after we learn about the constellations and such."

Another teacher explained his approach. He said "I teach the subject areas, such as science and social studies, as reading. That's how I work it in. If someone says 'What are you teaching?', I say, 'Reading, in the science content area.' and using science text material as the reading book."

- **The Butterfly Garden is a center for science activity, and a growing identity for the school.**

About five years ago the SRT introduced butterflies into one of the third grade science classes. The students were able to raise butterfly larvae and watch them turn into caterpillars and beautiful butterflies. They drew pictures, wrote poetry and songs, and were involved in a variety of other activities around the butterfly theme. The program expanded into other classes, and is developing into a major theme for the whole school. Along the way it has brought a partnership between the school, the Smithsonian Institute, and the National Zoo, as well as bringing other community and business support to the school. The US Department of Agriculture helped the school plan and build the butterfly garden. The Director of the National Zoo is involved in the Butterfly project, and the zoo recently published an article about this project in their zoo newsletter.

The SRT initially brought the butterflies into the classroom to give the students "exploratory experience." A few years ago they added a garden, in the shape of a butterfly, growing flowers that would attract butterflies. They called it the Butterfly Garden. In the spring a celebration is held, called the Butterfly Explosion. At this event the students release their butterflies, and there are songs, dance and poetry on behalf of the butterflies. Last year the celebration was attended by a variety of community people, including parents, PTA president, the district councilwoman, and leaders from the Department of Agriculture and the Smithsonian Institute.

The SRT remarked "[The Butterfly Garden] is beginning to touch all areas. A lot of people interested in what we are doing."

She talked briefly about the positive effect the garden was having on the school. She said that "it has improved [science] for the school as a whole. I believe it is because of the butterflies, and good personal relation I have with the teachers."

She also talked about taking care with a new program, cautioning that the implementation should be done slowly. She said "You have to create a program step by step. When people are not familiar with what you are doing, you are given limited space to spread out. I started with the third grade, my core group, spread it to the primary levels, then the intermediate levels got involved. With the assembly [Butterfly Explosion] only the primary level has been allowed to participate, to be there. This year the intermediate teachers are saying to the principal 'Why can't we be included. You have excluded us?" This year they are going to be included. But you have to take it step by step. You don't want it to be destroyed."

- **The SRT is very much a science education activist, and the cornerstone of the special science programs, such as the Butterfly Garden and Life Lab.**

The SRT initiated the project that became the Butterfly Garden and the Butterfly Explosion. She is responsible for bringing Life Lab to the school and manages the program.

One teacher spoke about the dedication and accomplishments of the SRT. She added, "You have to have someone like her to really get things moving because she can get a teacher going. Our SRT is especially broad and active in this area. She gets around the community looking for resources, trying to get things going."

- **Life Lab fits in well with the Butterfly garden program.**

The principal believes that the garden is a way of motivating students to learn science, and also gaining responsibilities. She said "The garden also serves a broader function than just science. It means that some children are interested in school, because they're working under the direction of an adult who seems interested in them. They see something that comes out of what they are doing. Some of them may need those skills for later; sticking to a task, actually being able to do something that's constructive, feeling some success."

She also sees that gardening can help bring beauty into the children's lives. She said "The children don't see a lot of flowers and beauty around them where they live. Really enjoying it for the beauty of it. When you say 'flowers' I would like to know what some of the children think of....Even in an inner-city area people have a little pot of flowers. We want them to see that, we want that to be a part of their growing up lives. They'll be so much better for it."

Life Lab has been part of the school science program for a short time. Five teachers have been through the Life Lab training. The teachers we spoke with expressed enthusiasm for Life Lab, and how well it fits in with their programs.

The SRT said that her approach to using Life Lab was similar to her approach toward other science materials. She said "I am not using Life Lab as a total program, not following it in a sequential order. I pick and choose according to my needs."

She pointed out that some of the science activities in Life Lab are much like other science programs, but with a different emphasis. She said "SCIS used buttons for classification. You can use seeds to do the exact same thing."

The one other teacher who is involved with the Butterfly garden is also doing Life Lab activities, but surprisingly he had not yet taken the Life Lab training. As one person explained it, "He took the curriculum and began to work with it because he was interested in plants."

This teacher spoke highly of the Life Lab materials he was using, and also emphasized that he uses lots of different resources in his teaching. He said "When I want to teach plants, I found activities in the Life Lab which were the exact things I want to demonstrate. They were the best sources of materials I've used. I've used a lot of things out of Life Lab. In my class the Life Lab materials work really well. But I use a lot of resources here."

- **Having a garden creates opportunities for motivated, as well as troubled students.**

The SRT explained that she brings two special groups of students out to the garden--the science club, and the garden crew. She said "I have a science club. These children are mainly the better academic students. The garden workers I chose the trouble makers, to get rid of some of that excess energy. They have been tagged the Garden Crew, so that no one is slighted. I will work with each of them on alternate Fridays."

One of the teachers commented on the ownership and responsibility the students gain from working in the garden. She said "We thought that if more children could participate in doing it then they would feel responsible enough to preserve it, not to destroy it. Children in the neighborhood, who live near, would probably say to someone 'Don't do that, that's ours'.

The principal spoke with encouragement about the benefits that would be gained by maintaining an ongoing garden. She said "If it could be an ongoing project for our school, it would say something to the children here, for always, that we have a Butterfly garden. . . We want to carry it on. Something that the children grab onto. They love it. It opens the beginning life cycle concept to them, helps them to like the outside more, gives them feeling for 'this belongs to me.'"

- ***The Growing Classroom* gets mixed, but generally positive reviews**

The SRT, who has had the most experience with *The Growing Classroom* (TGC) listed a number of the positive aspects of the curriculum. She said "I think it's written very informally. The goals and objectives are very good. It focuses on nutrition, balance of nature, a lot of botany, measuring, classification. All that is useful. It has clear goals and objectives for each lesson, enunciation of skills, materials and procedure, follow the scientific method. It's a problem-solving curriculum."

She added that she uses it "more or less as supplementary program. It's not a conventionally tight structured program." She also identified that the Life Lab curriculum deals substantially with aspects of plant science. "You need the animals aspect, and physical aspect, if you want to make it a complete science program." she concluded.

One of the teachers said that the materials are very good, but cautions that you have to adapt it to your own program. He said "The diagrams are excellent, such as the root windows that we are making. They can see what the finished product is supposed to look like. But you have to adapt it to whatever you are doing. The reading level for some children is too difficult, that's why I do a lot of oral reading, so they all can hear."

Here is one example of a first grade classroom in which we observed a science activity.

> *There were 23 students in this class; 3 were white, 1 Hispanic and the rest were Black. They were having a lesson about seeds. The students gathered around the teacher and a table where there were different types of seeds laid out. The lesson was especially calm and orderly and anytime there was*

> *much student movement or commotion the teacher asserted herself and had people calm down.*
>
> *In this lesson they were looking at different kinds of seed they would be planting in the next week. The students got excited with each new seed they heard about. "Plants come from seeds" the teacher said. "How long will it take for the plant to start coming out of the seed?" she asked. The students guesses ranged from one week to seven weeks.*
>
> *The students wanted to know the answer. The teacher said "It's best when you find out something than when I tell you." The students asked more questions and at one point the teacher said, "Teachers don't know everything" and one child whispered in the background "God does."*

START-UP AND IMPLEMENTATION

- **The school is challenged by implementing a year-long Life Lab garden curriculum. The garden program needs a regional model, not a California model.**

Washington D.C. does not have a year-round climate for growing food outdoors. This presents a challenge for a school gardening program. One person explained "We're not garden-oriented in the winter on the East Coast". Another teacher, commenting on her experience from the Life Lab workshop said, "The lady who did the class, she was from California. And here we are on the other end of the United States, and she's showing us California-type things. I said 'That's great for out there, but to do it here?' To start our Life Lab in the classroom, with our seedlings--if you're not on the right side of the building it's not a success."

The principal also had her doubts about having a garden during the winter. She said "We've only had Life Lab for one year. I didn't think through its [the garden's] demise during the winter. You know, it's dormant in the winter. . . That didn't occur to me initially. Spring, summer, fall, it looked real nice. And then it disappeared."

Despite these challenges, the SRT plans on developing a summer garden program. She explained, "Last year we didn't have anyone to maintain the garden in the summer. That's why I want to get a summer program going this year. It was amazing to me that the summer personnel who were here were afraid to eat the vegetables. I thought 'That's really strange. The children are eating the produce, and it should open these other people's eyes that these things are edible.' It's interesting how little children are very eager to try. You can use them as a motivating factor to induce adults to do things."

She hopes to bring students into the summer garden program. She said, "[This year] I am going to select children who I have worked with who basically do not have anything to do in the summer, to pull them out of the streets. And provide some activity in the morning, maintain the garden, keep them out of trouble. I'm trying to get the district to fund it."

- **The lack of money is cited as a significant obstacle to improved science education**

The lack of money was cited by many people as one of the principle limitations to offering better or expanded science programs.

The principal made this point a number of times, in regards to equipment, supplies, teacher preparation and training, and cooperative learning activities. For example she said "We don't have the money to provide the equipment on an on-going basis. . . If we had more money we could do more. We could buy the things and have them on hand."

In terms of the butterfly project and the garden money is also an important issue. The principal said ""You need money to have any kind of viable program. Last year, after the children went home in the summer, the weeds were trying to take over. We had to use school funds to get a couple of boys, to weed the garden. Those kinds of tasks for children, even on a stipend, encourage them. It gives them some money, helps to keep their skills going, and helps our project."

The principal also spoke about the advantages and costs of bringing in adult supervision for when the students are outside, in smaller groups. "In our public schools, we don't have as much [activities] as we could because we don't have the resources. You need more supervision, one person can't take 20-25 children outside. There is a safety factor. You're at risk when you don't take every precaution possible." She recommends paying parents to help in the garden and supervise the children. She said "We can get parents in with stipends. They won't come otherwise. It puts the children more in touch with adults in a positive way."

The SRT also discussed her needs for additional funds. She was planning on writing grants to expand the garden, and other features of the school's science programs. She said "Maybe I can get some equipment for my classroom. Functionable microscopes. An Indoor growing lab, for example. It's more than a two-fold project that I have in mind."

Several teachers mentioned the need for additional resources. One teacher told a story about needing thermometers, but not having enough. She said "Our SRT went around to every school to get them , and we still did not have enough. We didn't have enough beakers. It was a joke, we really don't have supplies." Another teacher commented that "We have to work with kids in larger groups because of fewer supplies."

DISCUSSION

Alexander, like other inner-city schools, faces the challenges of working with children in a desperate environment. By focusing on the basic skills and emphasizing science programs they are trying to help them be prepared for life in the next century. The emphasis on testing inhibits the free inquiry of the students despite the desires of the principal and teachers.

The Butterfly project is a wonderful metaphor for the dreams and hopes the teachers hold for their students, and the experiences they try to give them in school. The principal seems especially supportive of programs or a curriculum which teaches an appreciation for the science and aesthetics of the natural world. Life Lab is particularly well-suited to Alexander because they already have a garden in-place and a science specialist fostering an environmental curriculum. As the Life Lab program develops, the SRT will probably be able to make the curriculum more available to other teachers.

However, it is not obvious that the garden will be available to others. Only two teachers were using the Butterfly garden when we visited the school. I suspect this is because the Butterfly garden is the creation of the SRT, and she maintains tight control over its use. Will other teachers get access to the garden? They will need to expand the garden area substantially to accommodate other classes.

The SRT is very dedicated to teaching science. But the science curriculum at Alexander is quite fragmented -- textbooks for the fifth and sixth grade only, each teacher doing their own thing (if they do any science at all). The SRT will have to work hard to unify the science curriculum, as well as make Life Lab an integrated part of the curriculum for everyone. perhaps the forthcoming Life Lab textbook will be a resource that all teachers can use.

It is not clear what other efforts are being made at Alexander to improve science teaching. Will all teachers be trained in Life Lab, or some other special science program? With the lack of funds, how well will the school be able to support teachers' if they are trained? Will the teachers have the resources they need for teaching science?

BARNEY ELEMENTARY SCHOOL, WASHINGTON D.C.

> *This is a high crime area. Ninety eight percent of our students have been exposed to a societal problem, like drugs. For some of them to get up out of bed and get to school every day is a miracle.*
>
> *Principal*

This report presents a case study of the Life Lab Science Program at Barney Elementary School, in Washington D.C.. Dr. Mark St. John and I visited Barney for one day (February 21, 1989). During our visit we talked with teachers and administrators. Additional information on the D.C. Public Schools (D.C.P.S.) educational and science programs can be found in the Introduction to D.C.P.S. This report is organized around the following subject headings: Summary statement, School and the Community, School Leadership and Curriculum, Science Teaching and Life Lab, Training, Start-up and Implementation, and Discussion.

SUMMARY STATEMENT

The Life Lab program at Barney Elementary is characterized by enthusiasm but a lack of resources and experience. Barney is located in a very poor, run-down section of Washington D.C. Basic skills, "without a lot of frills" are the hallmark of the school's curriculum. While the principal acknowledges that while science is increasingly important, the school has few resources for science teaching. There is no Science Resource Teacher. Life Lab has been at the school less than one year, and the teachers who have been through the training are very enthusiastic about the program. They have taught few lessons from Life Lab's curriculum books, but are incorporating

Life Lab concepts into their own lessons. There are hopes for an outdoor garden, but they have yet to find a satisfactory location for a garden.

SCHOOL AND THE COMMUNITY

Barney is a multistory brick building located in the northwest section of Washington D.C. The people in this inner-city neighborhood are primarily poor and Black. The area is not well-kept, with garbage littering the streets and sidewalks, buildings abandoned, run-down, or closed. The school building itself is well-maintained, with hallways and classrooms painted bright green and pink. Students' artwork and theme-based displays are prominent throughout the school, but do not cover all the hallway walls. Student science fair projects are on exhibit in the main entrance lobby. Other posters or banners herald the districts motto "Keys to educational success: Accountability, Efficiency, Effectiveness." This motto is repeated, in some form, in nearly all the Barney classrooms.

There are 671 students at Barney and over 95% of the students are Black. Over 95% of them are from low income families with single mothers. Almost all of the teachers and staff are Black or a multicultural mix. The students are dressed very neatly in appearance; hair braided, wearing warm coats and rain coats for this day of inclement weather. There was little noise in the hallways or coming from the classrooms. There was an air, or sense, that discipline and orderliness are the most important values at this school.

Science is an increasingly important part of the curriculum at Barney. Life Lab has been at Barney for a very short time, (several months at the time of our site visit) and is only in the pilot phase. Despite its brief time at the school, there is considerable enthusiasm from teachers and the principal on behalf of the Life Lab program. They spoke positively about the teacher training, the Life Lab curriculum materials, and the overall philosophy and approach of Life Lab to science education, and how it fits with their own educational needs. While there are a variety of plants growing in planter boxes in classrooms, they have not yet started an outdoor garden.

SCHOOL LEADERSHIP AND CURRICULUM

- **The explicit role of this school is to provide a basic, solid foundation in preparation for life. It is a great challenge to motivate these students because of their depressed community and home environment.**

The principal explained what her educational goals are at Barney. She said, "We are working to educate our children to have a solid foundation in preparation for life, without a lot of frills. We emphasize on reading, writing, arithmetic, and science. We want to make sure the basic skills are taught. Kids must be able to function in our society."

The challenge to meet these goals exists because of the poor and depressed environment in the surrounding community and the children's homes. The principal said "We are talking about children, where 97% of the student population is from the public housing project. Ours is a high crime area, and I would say 98% of the population has been exposed to a societal problem, like drugs. For some of them to get up out of the bed and get to school every day is a miracle. For them to have the kinds of problems that they have at home, and then to come to school and get involved in the educational program, and then excel -- I think it is extremely good."

She explained that the ability of the school to meet this challenge came from an experienced and committed group of teachers. She said, "Ours is a traditional school. The children are taught by experienced teachers as opposed to beginning teachers. I've been at this school since 1971, and half of my teachers have also. We have teachers who care, and who are prepared and want to provide the structure . Our teachers are genuinely interested in children. Our student population needs that, because most of them do not come from a structured environment and the teachers are providing them the first opportunities to work in a structured situation."

- **The Life Lab gardening program provides an environment where children have a sense of ownership, and self-worth.**

The principal and teachers recognize that students involved in gardening are getting opportunities they don't have at home. These are opportunities for ownership, for success, and building their self-esteem.

The principal said "I strongly believe that ownership brings about a change in self-worth. If you won something you are going to take care of it, you're not going to destroy it. Once the children plant their garden they are going to have a different attitude. They could actually see things that they planted and see that the seeds grew, and that they have flowers because of something that they were able to do."

- **The school's curriculum is primarily based on the Competency-Based-Curriculum. Life Lab represents an ambitious move beyond this basic curriculum.**

As in other D.C. schools, the Competency-Based-Curriculum (CBC) forms the basis for the schools science teaching. The principal explained that she wanted to give her students additional experiences, so they chose Life Lab. Her goal is "mesh the Life Lab curriculum in with our curriculum to expand the children's experience." She is excited about the hands-on emphasis offered by the Life Lab curriculum, an approach that differs from their traditional science teaching. She said "Life Lab is more ambitious. It involves a lot of hands-on experiences for the children. The children can actually get involved in planting, seeing things grow, see how some of the information affects them as far as their nutrition is concerned. This is totally different."

- **The principal is trying to help teachers overcome their fear of science.**

The principal thinks that one of the failures in teaching children about science has been the teachers' own fears about science. If the teachers aren't prepared, the students lose out. She is trying to help teachers overcome their fear of science by capturing their interests and supporting motivational programs like hands-on science and the Life Lab program. She said, "We put a lot of emphasis on science, and we are trying to expand our science. On the elementary level, teachers have a tendency to teach language arts. A lot of teachers are afraid of science and they will not incorporate it as they should into the curriculum."

She continued, "Especially on the elementary level, I think that we have to motivate the teachers so they will want to teach the courses that they are afraid of teaching. If we don't motivate children so that they will want to learn those subjects that are difficult, they will never learn. If we as administrators don't motivate the teachers so that they will want to motivate the children, then nobody learns. "

SCIENCE TEACHING AND LIFE LAB

The emphasis on science described by the principal was supported by a number of observations made in the school; science fair exhibits displayed prominently in the school's entry way, science teaching materials in the resource room, and in conversations with various teachers.

For example, in the entry way to the school there were a number of science fair exhibits, on such subjects as Rockets, Volcanos, Dinosaur Time, "Growing seeds without soil", The Brain, Solar System, Stratosphere, "Seedy characters", Heat absorption, Helicopters, Earthquakes, the Digestive system, Geotropism. Of these dozen exhibits one third were Life Lab-related.

One teacher said that she felt Life Lab was especially appropriate because it deals with things that are part of the students surroundings. She explained, "I've found that they are not aware of science in their everyday environment. Working through the Life Lab activities, they become more familiar with science as part of the everyday world.

Another teacher commented on how much more effective hands-on science was, than the traditional lecture format. She said "I find that the students enjoy science because of the hands-on nature of it. But when you lecture to them, they don't seem to enjoy it. When they are able to actually do something, even a small experiment, they love it."

Another teacher commented on how students gain responsibility through doing hands-on science and group work. She said, "I find that leadership qualities come out. A leader emerges from each group, and is able to carry the group through the whole process."

- **The teachers we spoke with were very enthusiastic about the impact Life Lab has on students and their curriculum.**

Teachers are excited about a number of the qualities and experiences gained from working with the Life Lab program, including group-building, the positive response of their students, the way Life Lab integrates with their own curriculum, and the interdisciplinary approach.

When we asked several teachers "What is the main thing your kids get out of doing Life Lab?" they all responded at the same time, with a variety of answers. These responses included "They get hands-on type of activities." "They draw their own conclusions." "Classification." "They get a lot of input in it." "They get in groups and work."

One teacher explained that her students are learning to work together. She said "They have a chance to do to work together. The more they have this kind of activity the more they learn how to work together. Plus the keener their interest becomes."

Another teacher spoke with relish about two experiments her class did; Mystery powders, and planting radish seeds. She felt both were very successful, with surprising outcomes. She first described the Mystery Powders experiment. She said, "It was really interesting, because the children were told that they could not talk as they went from one type of powder to another. The powders were numbered from 1-6. There was sugar, salt, soap, confectionery sugar, baking soda. The students were supposed to go to each cup and use any sense and decide what this white powder in the cup was. Absolutely no talking. It was difficult for them to be quiet, really difficult. I had to continue to remind them to be quiet. They went from cup to cup. Most of the children tasted it, and a few smelled. Then we went around the room, each person telling what they thought the powders were. Most of them got at least five out of the six right. They thoroughly enjoyed that."

She described another experience they had when the students were working with soils. "Every child planted radish seeds. One box had just plain potting soil, and the other one had potting soil with cow manure. When I told the children this was cow manure, they thought it would have a horrible odor. When I opened it, they were totally surprised that it had no odor. They said 'It looks just like soil.' Anyway, they made predictions about what would happen, that the radish seeds planted in the soil mixed with cow manure would do better. You know what? They didn't. They grew better in the regular soil. And then the students wrote stories about their plants. They kept an on-going journal about their radish seeds. I have those stories in a book for the class."

Another teacher spoke glowingly of her experiences with the curriculum *The Growing Classroom* and Life Lab activities. "In my class we are using the curriculum guides *The Growing Classroom* which are excellent. What makes them good? The experiments, the vocabulary, the format, everything about the curriculum. I think it is a good introduction, before we get to the actual garden. The students interest is piqued. The longer we work with the different experiments in the books, the more eager they will become to have this garden, to care for it, to have that interest that they will carry home to the parents, and therefore the parents will be interested.

One 5th grade teacher pointed out how the use of the Life Lab activities enhanced the students use of language. "We did the Mystery powders activity. We were able to get them to write more about it. They talked about consistency, taste, color. Corn starch is real silky. They were able to use those types of adjectives, like silky', that they wouldn't ordinarily use. You could see the excitement on their face. They said 'When are we going to do this again?'"

One teacher described how pleased she was with how well the Life Lab activities integrated with her other activities. She gave one example, of a geography lesson she developed, modeled after activities from *The Growing Classroom*. She said, "I'm working on a unit like Life Lab's Life Cycle. The school called it the 'Food Chart'. I incorporated Food Chart unit into the Life Cycle unit we were doing. We were studying geography There's one activity from *The Growing Classroom*. where you have an apple, you cut it up in pieces, and it represents how much water on the earth you can drink. That fell into place with the unit on geography, as an introduction to my unit."

Finally, one teacher described a creative way she taught the concept of food webs, bringing in drama and role play to enhance the student's understanding of the principle concepts. She said, "I taught the food web, the life cycle. As the end product, we did a role play. For example, one student was the mouse or the chicken, one was the sun. They enjoyed the role play of the food cycle. Because [when I first introduced the food web concept] they didn't understand. They were able to understand when they took on the role of the animal. It worked out real well."

The building resource teacher works with many of the students in the school, from "at risk" students to enrichment programs, first through sixth grade. She described her experiences with bringing Life Lab curriculum into her teaching. She said, "I've incorporated Life Lab mainly with the first graders, and in both the at-risk and enrichment program students. We worked on a lesson of classification of seeds, and did it very well. We planted seeds and watched them grow. I also work with the children on the science fair and I was able to use some of the Life Lab activities in the science fair."

TRAINING, START-UP, AND IMPLEMENTATION

- **The Life Lab Training was a key to motivating the principal and teachers to want to try Life Lab at their school.**

The principal described her experience with bringing Life Lab to Barney. One of the reasons she chose Life Lab was because she was impressed with easily how it could be easily meshed with the school's curriculum. She said,

> *My 6th grade teacher went to a Life Lab workshop that was instrumental in whetting her appetite. She was excited about the project and asked me if I would accompany her when she went to the workshop. I did, and I was impressed with the structure. I was also impressed with how it could be easily meshed into our curriculum. I found that everything was there in the curriculum, it was just a matter of the teacher following it. And it wasn't threatening. It was something that was enjoyable.*

- **Teachers wanted more time for the training, because there was so much material to cover.**

A number of teachers explained that while they enjoyed the Life Lab training, they wished they could have gotten more. One teacher said "You know, we are city people. I think I need a little bit more training in the soil aspect, how to tell what nutrients are in the soil." Another teacher remarked "I think we need more background, it was like a whirlwind. It was quick." And another said "I think everybody wanted more time. There was just a wealth of information for us to digest."

One teacher suggested that the training be held at the home school, providing a smaller or more personal setting for the work. She said "When we attended the workshop there were people from different schools. There were a lot of people. If we could work directly at our school, where everybody has basically the same curriculum, and is discussing the same kinds of things, that might help."

- **Support from people, institutions, and money are critical factors in developing or sustaining Life Lab and science activities.**

Despite the enthusiasm and motivation of the principal and teachers, it takes other types of support to develop a Life Lab program. People at the school mentioned a number of needs they have that can't be met without greater support by the district, or money to pay for things. Some of these needs include: making Life Lab a school-wide program, training more teachers, gardening supplies like compost and a soil test kit, and developing a complete science lab.

The principal said money is essential to keep a program going. She said "I don't care where you go, it's the same problem: money, resources. The teacher interest is there, the support is there, the children's interest will be there because the teachers will motivate the children. So, it's money. The way to keep the enthusiasm going is to have the money so that they won't be turned off because they couldn't follow through on whatever they had dreamed about doing."

She was concerned about funding for Life Lab for the coming year. She said,"The D.C.P.S. gave money for the Life Lab pilot last school year. This school year we don't know, at this point, where the money is going to come from."

Teachers echoed this concern, when talking about some of their own needs for resources. One teacher said "Often times we don't have the funds to go in and get things we need, like fertilizer or compost" Another teacher said, "[I'd like it if] there were a place where we could go and get the supplies that we need."

One teacher lamented not having a soil testing kit, a tool which is essential for doing basic garden science experiments. Soil testing kits sell for under $35.00 She asked us, "Is it possible for us to get one kit for testing? We have tried to grow so many different things and we haven't been successful with everything. We need testers to find out why. If we could actually test the soil and find out why things don't grow..."

Another teacher spoke on behalf of increasing the school's science facilities. She said "I like the schools that have a science resource room. If we could have one ourselves, we could include all the experiments and all the activities. We used to have a science room, and an SRT, but when the budget was cut..."

In addition to the funding, the principal cited other types of support needed to keep a program going. She said "You need the support system, people who are going to follow through, people who are going to give you resources to kind of motivate you to overcome some of the problems that you've had. I don't think that one workshop or one project should be the final word."

She continued, "For the lack of proper words, I guess you just need to keep a program stroked. You've just got to have stroking. And if you don't, then it's going to fall apart. If the stroking is the support system or the monies, the removal of constraints, the interest of the person responsible for getting this moving in D.C.P.S., that person has to constantly be there for support when needed."

Despite these constraints the principal and teachers are resourceful. The principal described a three-part plan for establishing and funding a garden at the school. She explained, "Plan A would be that the school system would provide us with the materials. If they are unable to provide us with money, then Plan B would be to tap the resources within the community, our PTA funding so that we could get the materials that we needed. Plan C would be that we would have to go outside of the community to get organizations to give us some support."

- **The teachers at Barney cooperate with one another. They are their own main support.**

Both the principal and teachers commented on the support they give one another, even though, at times, it can be tiring. In discussion on planning the garden one teacher remarked "We were hoping to work as a team. We usually work pretty well together." Another teacher remarked, "There are people who go around and help the new teachers. I could use that now."

The principal said that teacher cooperation is a primary influence on how to get teachers motivated to do new things, or to stay involved. She said, "We don't have any choices around here. They all work as a team because they can't do it without one another. Nobody works by himself or herself."

She cited the Life Lab training, and bringing in cooperative learning, as two examples of how this works. For example, when her teacher returned from the initial Life Lab training, the principal encouraged her to involve other teachers. As the principal described it, "I said to her 'Share with your colleagues, and see whether or not you get some people who will support you.' The teacher who had been to the training was able to influence all of the people on her grade level, [and others] to participate in the workshop. They came back and they were enthusiastic about Life Lab." Similarly, when one teacher started using cooperative learning strategies in her classroom, a colleague noticed the difference and asked her to help him develop it for his classes.

But being your own support in a system that is low on funds can take its toll. One teacher remarked "The teachers have to do everything here. It gets a bit draining at times."

- **At present, the school lacks an outdoor garden area. All the Life Lab activities take place in indoor growing spaces. The school has a vision for a large well-supported community garden, but there are a number of obstacles to overcome to achieve this goal.**

We visited several different classrooms and noted what types of science and Life Lab projects were displayed. In most of these classrooms, there were a number of plant projects lined along the windowsill. They were lots of indoors planters, window box units, and experiments in milk cartons. In one class we saw several feet of window sill devoted to Life Lab activities, including 2-6"x36"x6" boxes with sprouting plants, milk carton experiments on root growth, and a glass sandwich experiment on seeds and moisture.

The school's vision for the garden is one of a large project that involves many people, perhaps a community garden. The principle obstacles to having an outdoor garden at Barney are space, concerns of vandalism, funding, and the maintenance of the garden in the summer.

The principal said "We want to have a large project, a school-wide project, as opposed to planting everything in the classroom. We felt that perhaps we could do some beautification this spring."

She added that projects that are applied, like creating a large garden at the school, are especially meaningful. She said, "I think that a lot of times we get involved in theory. The students don't get a chance to get involved in the application of the skills that they've been taught. I want to transfer some of this information into a big project, as opposed to transferring it into just some kind of things they would do in a classroom like planting seeds and that kind of thing."

While the school has a large playground and open area, they did not think this area was suitable for a garden because of its use for play, and concerns about vandalism. One teacher said "I don't feel that the sports area would be a good area simply because there are so many different groups of people who pass through there. I don't know that they would have the kind of interest that we have in that area. I think that it would be more effective if we took it out of the neighborhood to another area."

One teacher's idea for the garden was to have garden on the rooftop of the school. "We don't have the grounds to build a garden and one of the things that we have investigated was the possibility of having a rooftop garden at the school, but it's not happening yet."

Another one of the teachers cited problems with a year-round garden, parents' involvement, and the need for an appropriate site as being very important issues in having a garden. She said "The Life Lab could be a year-round project, but I don't think the gardening should be. Simply because we couldn't grow things here year-round. We can do indoor things, as we do now. In the latter part of March, we could start to plant things, and probably have some success. . . .We would have to depend on the parents to take over once a week when school ends. Or we would have to depend on the parents to allow us to come and get the children and take them to the garden at certain periods during the summer. That could work if we got the support of the parents. Having the five of us teachers on the team is good, but we would need time to really get that core group of parents working."

She continued, "But that will take awhile, because first we must find an area where we can have our garden. Then we must make sure that it's an area where we will have the cooperation of the neighboring community. I don't think we'll be able to have a garden in this area. It's going to take a pretty good while for us to get it going. It won't be impossible by any means. What I am doing is working up to that point."

DISCUSSION

The teachers and principal have a vision of Life Lab for their school which is very rich. The envision a community garden, a year-round interdisciplinary curriculum built around Life Lab concepts and ideas, and more teachers becoming involved. They are in the infancy stages of realizing this vision. They have no garden, no money, few resources, and no key person to sustain the effort required to create all these things. But they have a great deal of hope, for their children and their school.

CARSON ELEMENTARY SCHOOL, WASHINGTON D.C.

> *The school has to create an environment in which the students have to be self-motivated and desire to get the best of education, so they can have a choice down the road.*
>
> *Principal*

This report presents a case study of the Life Lab Science Program at Carson Elementary School in Washington D.C. During my one day visit (February 22, 1989) I met with the principal, interviewed the Science Resource Teacher, observed a few classes, and met with two Life Lab teachers at the end of the day. Four teachers have been through the Life Lab training; one was trained two years ago, another 18 months ago, and the two others were trained last year. Additional information on the D.C. Public Schools (D.C.P.S.) educational and science programs can be found in the Introduction to D.C.P.S.. This report is organized around the following subject headings: Summary statement, School and the Community, School Leadership and Curriculum, Science Teaching and Life Lab, Start-up and Implementation, and Discussion.

SUMMARY STATEMENT

Carson is an integrated inner city school, centered in a neighborhood in transition. The school's curriculum makes wide use of educational technology, such as computers and satellite video programming. Environmental education themes, and off-campus experiences are also important parts of the curriculum. Science teaching is done by both the classroom teachers and the school's Science Resource Teacher, and is integrated with other subjects. Life Lab is seen as being very compatible with the school's science curriculum, and students are excited about their Life Lab projects. The school has a beautification program which includes a large flower garden, does not have a vegetable garden, yet.

SCHOOL AND THE COMMUNITY

Carson is located in a Black neighborhood, in a low socioeconomic area in the southeast section of D.C. As the principal described it, "We have a number of apartments and families who are on public assistance, or ADC. About 65-75% of my kids are on free lunch. There are a high number of one-parent households, usually the mother."

The neighborhood has been in transition the past several years. The principal described the key features of this transition to be "drugs and townhouses" with a lot of people moving in and out of the neighborhood. In addition, there is an Air Force base nearby, and a number of Anglo and Black students are bused from there to Carson. This all helps create a very transient population. It also provides for racial mixing in what would otherwise be an all Black district.

The school building is a beige brick 3-story structure, with a paved playground and parking lot to the rear. The interior of the school is very neat and clean, painted a light cream color with bright linoleum floors. The walls are decorated with a illustrations of the life of Martin Luther King Jr., and other displays for Black History Month.

The principal and much of his staff have been at the school since it opened in the early 1970's. Classes are small, ranging in size from 18-22 students. "Enrollment is going down", the principal said. "One year we were up to 700, now we're down to 475."

Teachers at the school are rotated through the classes of different levels of academic skills for their grade level. Traditionally, teachers who have been in a school a long time will get to teach the "best and the brightest" in their grade level. To guarantee that all students will at some time get the best teachers, the principal rotates the teachers through the different academic levels in each grade level.

Science is a very important part of the curriculum at Carson They have a Science Resource Teacher, a separate science room, and a variety of programs and activities that emphasize both environmental themes, and the use of high technology. Interdisciplinary education is recognized as an important part of science teaching. In addition, the Washington D.C. community is almost part of the school campus, as many activities an events take place off campus. Life Lab fits in very well with this multi-program, experiential approach. While the school does not have a vegetable garden, they do have a flower garden and are involved in community beautification projects. They plan on adding a vegetable garden soon.

- **One of the main goals at Carson is to provide the students with a high level of exposure to ideas and technology. This is in part a response to what is perceived as deficiencies in the children's lives.**

The principal cited a number of deficiencies in the students' home life, including the lack of parental guidance and influence, and stability in their home life. This influences the school's educational approach. He said "The school has to create an environment in which they have to be self-motivated and desire to get the best of education, so they can have a choice down the road."

He continued,

> *Since our kids are transient, they don't have the resources you find in an average home. The school has to make up the deficiency if we want to put them into the so-called mainstream, or so they can be competitive somewhere down the line. . . We use educational technology to make up for these deficiencies.*

> *We are using the best of technology that's out there right now to provide exposure.*

- **The principal is ardent in his philosophy and approach to education.**

The principal discussed his multi-faceted educational philosophy, highlighting areas he feels are especially important at his schools. These areas include providing substantial exposure to science and technology, offering environmental/nature experiences, changing teachers and students attitudes, providing activities off-campus, humanizing the curriculum, and teaching students responsibility.

In the area of science and technology the principal said, "My main goal is to integrate technology in with all of the disciplines. To use it effectively to provide exposure to kids, and to get kids to enjoy learning. We are using technology to give them a broad background in education. They do not having access to certain kinds of information and data. So we take the technology and give the students exposure to all these different areas."

He talked about the values of ownership and responsibility the students gain through hands-on activities. "We try to get the kids involved, using hands-on kind of things. That way they are more apt to take care, and of course they are proud. "

He added, "We work on changing attitudes and once you change attitudes kids will do anything in the world to please you. That's why we try to involve the students as much as we can. We direct, but we don't insist. We let them do the problem-solving, come to the solution and completion. You make them a part of the process."

He explained that educating his students about the environment was also very important. He described an experience he had with a parent whose child was destroying trees. "I said to her, 'You live in an apartment complex but you don't tear up the trees there!' Not only do I have to get the kids to think in terms of why the environment needs to be preserved, I've got to expose it to the parents, too. Somewhere down the line they did not get it. They don't see the relationship between their life and environment and the long term."

The principal is committed to this work in the local community. He has been the principal at Carson for nearly twenty years, even though the school board has "wanted to move me around to other places." He added "I've got people downtown that want reports. I'm not concerned about reports. I'm concerned about getting that kid plugged in, so he or she has a chance out there. Because that will impact on me more in the long run."

- **For an inner city school, the facilities and curriculum are rich in high technology and environmental/nature experiences**

Within the school the students have access to a variety of educational technologies: computers, videos, a satellite dish, and public television programming. Part of this educational is the substitution of technology items in place of textbooks.

The principal described how he sees this technology fitting in with the school programs. He said "We don't rely on textbooks. We encourage teachers to use the media center, to use any means we can to get the current information to students"

He continued, "Computers, any type of media that's going to provide a greater exposure to the students. . . We also have a satellite dish. If possible we try to incorporate that media to provide expose to kids. For example if there is going to be a space shot, we'll schedule so kids can come down to see it."

By using educational technology, the principal hopes to encourage the students to strive for careers beyond that which they are exposed to. He said, "This is how you get kids to say 'I might want to be an oceanographer, or an engineer, or work on an airplane.' Everybody can't be an astronaut, but it takes a hell of a lot of people to get them up there, and to get them down."

How are these programs or technologies funded or supported? Once the technology is in place the programs are relatively cheap to operate. The principal emphasized that coordination is a key to making this work. He said "We rob, steal, and borrow where we can. What we've done, since we don't have any money is to be involved in projects where we can coordinate. If it doesn't cost us additional funds, or we have a resource that we can tap, then we participate."

- **Environmental activities are emphasized because the students aren't exposed to nature. This helps them learn respect and appreciation for the environment.**

In the area of nature and environmental programs, there are a number of activities offered in the school curriculum, including visits to parks, the Aquatic gardens, the White house garden, camping at Camp David, nature walks, road trips to the country, and the Thomas Ayres Outdoor Classroom. While all of these activities may not always be offered they represent the strong emphasis and diversity of the school's environmental programs.

The principal explained that most of the children aren't exposed to nature, and they lack a "point of reference" for understanding why it is important. He said "Most urban kids, all they know most about is concrete and asphalt. There's just not very much living stuff around." He added that the students need "proper information and not mis-information. All kinds of crazy information has been generated and the school has to filter it out."

For example, one of fourth grade outdoor activities includes a tour of the regional geography and rural areas. The students get to see cider being pressed, and peanut butter being made. They see the local landforms and waterforms, and study Chesapeake Bay.

One teacher described some of the other activities in which she had been involved. She said "One time we went to collect leaves so we could identify the types of trees in the city. We did nature walks. We went to Eastern Market and planted Crocus bulbs, in November. Then we went back in February to see if they bloomed."

- **The school is involved in a number of programs that receive support from the Washington D.C. community. However, programs come and go. They are not tied to one thing in particular.**

The school is involved in a number of programs that receive support from the Washington D.C. community, including a Beatification Program, Partnership in Education, the White House, and others.

The principal described some of their experiences with their adoption by the White House. "We have been adopted by the White House. The kids have been exposed to the White House Greenhouse. They've made trips down there and seen all the things related to plants. They've planted trees for Arbor Day."

The City Beautification Program involves a number of community people, including people from the neighborhood, a principle volunteer, and someone from the Mayor's Beautification Program. The students help plant flowers at the school, and around the neighborhood.

The principal explained that they are not tied to one particular program, but that they try and bring in whatever programs are appropriate for the time and place. He told one story about a drug education program for which the school had received national recognition about five years ago. He said people are still visiting the school to get information on that program, but the school is already on to something else.

SCIENCE TEACHING AND LIFE LAB

- **Science is an important subject area, and is well supported. The school has a designated Science Resource Teacher, and a science room. The multidisciplinary, or integrated subjects approach is a key element in science teaching.**

As in all D.C.P.S. schools the curriculum focuses around the goals and objectives stated in the Competency-Based-Curriculum (CBC). However each school will bring its own character and priorities to that curriculum guide. At Carson, practical applications, hands-on science, and an interdisciplinary approach are the priorities. The school participates in the science fair, publishes a monthly bulletin on their science program that goes out to parents, and as well as utilizes the other activities that have previously been described. This section describes how these areas are supported at the school, and how Life Lab fits in with this approach.

As explained by the Science Resource Teacher (SRT) "Science is one of the top priorities in the school system, period. Because of the new emphasis on technology and energy, we are trying to keep current."

She continued "Most of our teachers do teach science in some form everyday. The one thing that I tell the teachers is that science is everyday living. From the minute you get up in the morning."

A few teachers we talked with affirmed this commitment to science teaching. One teacher said "I teach science five days a week. My kids love science." Another teacher said "At some point during the day you're always doing something related to science."

Another teacher explained how she integrates writing with science. She said, "My main objective is to correlate science with the other subjects such as math, language arts. Which is why, even though they are doing an experiment, I get them to write about what they have done. When they bring in bugs and insects, we have them, write about that also."

Another teacher explained how she integrates science into her busy day. She said, "You have to recognize that you are doing science. Before I came to this school, I can think of times when I came to the end of the day and said 'I don't have time to do it.' But when you deal with watering flowers in the morning you are dealing with science. All you have to do is take time to measure the amount of water that you are adding to your plant. And you're doing the math at the same time."

The principal explained his rationale for the emphasis on an interdisciplinary approach in teaching. He said "There is a relationship with everything, all the subjects. You don't say 'We can't talk about this because it's not science time, or social studies time, or geography time'. You need to be talking about all of them being connected in one continuous cycle."

The SRT said that she emphasizes a multidisciplined program, bringing in reading, writing, and math into science. She said "I try to stress a multi-disciplined program, rather than just isolated instances, and show that while you have reading and math you can also have science. I also stress to the teachers that when they have the students write in their journals that they write on science experience. That might be one way of getting in their science for the day."

One teacher talked about how well the interdisciplinary approach was working in her class. She said "Once you start doing it, you sort of get used to it. A lot of the science skills correlate with Language Arts, and Social Studies skills. For instance, in math we are doing measurement. That's one of the science skills. In the science fair project, a lot of the kids used a graph because being able to read and interpret a picture graph is one of the skills they've learned."

Another teacher talked about a creative way she was bringing all of the subjects together in her lessons. She explained "We made up a formula in my room where the reading and the math go together with the science. It's called the 'CBC science math formula.' For example, our spelling this week came from the Life Lab Earthworm and castings experiment. We took all the words we felt we could use that we thought were important. We counted the consonants, the vowels, and made a formula. We had math, reading, science, and phonics."

One teacher was especially pleased with the way her students had taken to animals in the classroom, and how this has helped with her curriculum. She explained, "In my room we have hermit crabs, and I notice that there is nothing in the curriculum about hermit crabs, but the children live for these hermit crabs. We've done a lot of lessons on the hermit crab, its habitations, gentleness, reading, spelling, science, art. We've done everything with those hermit crabs."

- **The Science Resource Teacher is a leader in science teaching in the school.**

The SRT is a science teaching specialist. She is familiar with all the school's science programs, texts, and was one of the people from Carson initially trained for the Life Lab program.

She explained her responsibilities at the school, which include demonstration lessons, special activities, providing special equipment teachers might need, bringing in resource personnel, and set up for field trips. She said "If I happen to go into a classroom, and I see that I can tie something in with the science lesson I call it to the teacher's attention. I feel that is part of being a resource teacher, showing them how to use what they already have to incorporate another program."

She maintains a resource room for daily science activities, and presents lessons in all the school's classes 45 minutes a week. She also runs the Science Club, a volunteer student organization for 4th-6th grades. These students are involved in lots of projects around the school, including the large flower garden and other beautification projects on campus.

In terms of the curriculum, she is firm in asserting that she is primarily responsible for teaching what is called for in the CBC. She said "First of all I get paid to teach CBC. . . I'm really held accountable for it. A lot of what is in the CBC is background information, so if the teacher is not familiar with it I can help them out. . . After the teacher's review their objectives, then they can let me know which objective they want me to teach. I will teach that particular one."

One teacher confirmed this approach. She said "[The SRT] provides us with a sheet prior to her coming into our classroom to inform her as to what we want her to reinforce or teach. We follow-up whatever she does."

While there is no official science textbook in the District, the SRT uses the Silver-Burdett series at the school. She likes it because it correlates well with the CBC and has additional supplementary materials.

One of the special programs the SRT is responsible for is the Science Club. This club offers motivated students additional opportunities to be involved with special science projects, like the science fair or the flower garden. The Science Club meets during school time and is comprised of a selected group (about 20) of 4-6th grade students. "They help carry on all the special activities," she said. "For example, when it is time to plant they help, or help do classroom activities. They'll come in throughout the week and take care of the plants, and fish, whatever needs to be done."

- **Life Lab fits in well with the CBC, and the school's curriculum. The SRT actively helps incorporate Life Lab activities.**

As the science specialist, the SRT was responsible for coordinating the Life Lab program in the school; helping teachers with their curriculum and activities, and providing needed materials. She received the Life Lab training in 1986. (The following year the 5th grade teachers were trained and this year two 2nd and 3rd grade teachers were trained.)

She said "The strength of Life Lab is the ability for it to be adapted to our program. Also, working with living things, because the children get excited about science. . . Life Lab is a perfect starting point for doing science."

Life Lab also works well at the school because they were already growing a flower garden, and had managed other beautification activities for several years. She said, "We were doing Life Lab before Life Lab came to our school".

She explained how her experience with an environmental education program, the Thomas L. Ayres outdoor classroom, tied in with Life Lab. She said, "We've been participating in the outdoor classroom for the last 5 years. As a result of being in that program, when Life Lab came along it tied right in with some of the same objectives as the outdoor classroom."

She explained that Life Lab is incorporated into the traditional program at the school. At the beginning of the school year she will compare the CBC objectives with the Life Lab activities, and then offer a brief outline of these things to interested teachers. She would like to do a more comprehensive coordination of the materials, but hasn't had time to do this yet.

She offered two examples of activities she has coordinated. One was for 2nd grade, the other for 5th grade. She pointed out that in 2nd grade students are growing plants, as described in the CBC for this grade level. "This fits in nicely with Life Lab" she said. In 5th grade the students are classifying rocks. Life Lab has an activity called "Everybody needs a rock" which they use for this lesson.

The principal agreed that Life Lab was a good match for their curriculum. He said "When Life Lab came last year, there was nothing we had to come up with from scratch. It supplemented what we had been doing all the time, except for adding a garden. So we could grow from a small embryo up to a mature program by adding on, when possible, with no additional cost."

One teacher, who did not receive the Life Lab training but was familiar with what the other Life Lab teachers did, saw similarities between the traditional curriculum and the Life Lab program. She said "I haven't been doing the Life Lab. But I'm finding that a lot of the things that they are doing in the Life Lab are some of the same things that we do."

I made observations in several classes, a few of which were doing science lessons during our visit. Here is one example (taken directly from my field notes) of a lesson and classroom where Life Lab was seen and used as an integral part of their science program.

- A 4th grade classroom.

> *A large poster at the entrance to the classroom reminds you that this class is doing science. It says "Life Lab: Lets Get Growing!"*
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> *There are many plants along the wide window sill, in various stages of growth. "This is our Life Lab" the students tell me, and they describe what they are growing and any experiments they are trying with the plants.*
>
> *The students were doing their spelling lesson, and all their spelling words were related to a project they are doing on earthworms, which is connected to their Life Lab science*

> *program. Their words for the day were "soil, tiller, castings, earthworms, air, recycle, tunnel, fertilizer, digestive, plants." On the wall next to the spelling assignment there was a large colorful poster about composting.*
>
> *Students eagerly gave me a tour of their room, and their projects. They guided me to their compost experiment, in which they had filled a plastic bag with all kinds of stuff, closed the bag, then open it periodically to see what is going on inside. On the wall is a large list which describes what went into the bag, and some of the student's guesses about what will happen to the material in the bag. Another two students showed me their science fair projects; one on coral, the other on robots.*
>
> *The most exciting thing in the class for some of the students were the three hermit crabs. The students handled them carefully and explained to me what they were learning about the life of the hermit crabs. I asked them "Where are they from?", and one student explained that they live in the sand at the beach.*

One teacher commented that Life Lab, along with the renewed emphasis on science education, reinvigorated her interests in teaching science. She said "I've been teaching for 22 years. I've noticed, in these last 4 or 5 years of teaching, that it means more to me now, especially with programs like Life Lab. It gives the children a more in-depth meaning for education, because the world is leaning toward science, in a big way. I notice the children are more interested. The more interested the teacher is, the more motivating it is for the children."

- **Teachers like *The Growing Classroom* and use the activities in it.**

The SRT explained that all the teachers who have received Life Lab training have a copy of *The Growing Classroom* (TGC). She remarked that the "value of the TGC is very good."

One teacher said, "I use it every day, and study the book myself at night. Because with children you have to be well versed on what you are talking about. I keep the book at hand so I can refer to it. When I'm writing up my plan I use the book. I can pull lessons directly out of the book."

Another teacher said "It's a teachers guide. It's not for students, but I reproduce from the book. I pull information from the book and make up my own chart."

START-UP AND IMPLEMENTATION

- **The school does not yet have a vegetable garden. They need to find a space for the garden, as well as work out other logistics in managing it.**

The principal is supportive of creating a gardening area. He believes that having a garden gives the students a chance for ownership in their work. He said "They plant it, they take care of it. If I plant it, they destroy it."

The SRT explained that right now most of their Life Lab activity goes on inside, in planter boxes or using potted plants. The principal noted that "the kids have always been growing stuff in the classrooms."

Both the principal and the SRT spoke encouragingly of adding a vegetable garden space soon, but neither could foresee quite where it would be or how soon. The SRT said they want to put a garden on the roof but the District has not allowed them to do so yet. "We are working through the bureaucracy on that one." And the principal added "We're still in the process of developing one [a garden] across the street where we have a lot available to us. They wanted to put one on the school grounds but we've had a little problem with that one. I wanted to put it on my roof, but they wouldn't let us."

Experience with the flower garden has shown that maintenance in the summer is an issue. In the past the custodial staff has done some summer maintenance, but it has not been adequate and is not really part of their job. The SRT said she envisions a summer program that will provide opportunities for the kids to work in the garden in summer. She expects that this type of program would require some of her own time as well as volunteer time from parents or other people in the neighborhood.

DISCUSSION

Carson is a school invigorated by a variety of programs that draw on both the natural and high tech environments. This stimulates the principal, teachers, and students. Rather than trying to explicitly provide a "safe oasis" for the students, the principal is trying to expose the students to many ideas -- to motivate them, to encourage initiative, to prepare them for careers in a transforming world. Life Lab is one part of this preparation, helping the students gain an appreciation for the natural environment, and the sense of ownership that comes from doing applied work, like growing plants. However, Life Lab may not be any more special than many of the other programs that have come and gone at the school. In a few years time, if a vegetable garden has not been started, Life Lab may not survive.

CHAPTER 5 DISCUSSION OF FINDINGS

The purpose of this research was to study the Life Lab Science Program as it is being implemented at selected sites. I have tried to let each school tell its own story, rather than focusing on cross-case analysis. However, there are certain issues that emerge from these studies which seem important for science education and the Life Lab program. I have arranged the discussion of these findings into the following categories: 1) factors that contribute to a successful Life Lab program, 2) ability for teachers to teach science and Life Lab, 3) students learning of science, 4) "Is Life Lab science or is it gardening?", 5) Life Lab transforming science education, and 6) Comments on Implementation.

The five schools included in this study represent a range of levels of program implementation, from very high implementation, as in Marsh Elementary, to very low, as in Barney or Carson. Each school has its own culture, social and academic needs. Despite these differences in needs, Life Lab has shown itself to be a very adaptable program. In inner city and rural areas, among multi-cultural and homogeneous populations, with well-funded and poorly-funded science programs, Life Lab is being made an important part of school science programs.

Factors that contribute to a successful Life Lab program

Factors which contribute to a successful Life Lab program can be grouped into three main categories: Broad involvement and support, Resources, and Conditions.

- **Broad involvement and support.** A successful program involves people and support in a number of ways: the school district, the principal, a lead teacher or science specialist, a corps of committed teachers, enthusiastic students, a gardening expert or advocate, a garden aide, volunteers in the garden, parents, community members (such as businesses, organizations, colleges), and fund-raising activist. Within this group, the two most important players are the principal and the lead teacher. It is through their ongoing attention and efforts that the Life Lab program is sustained. The principal helps direct and encourage the program, and the lead teacher provides the day-to-day and practical experience with the students.

- **Resources.** Life Lab is a resource intensive program, especially during the start-up phase of implementation. Apart from a standard allocation of funds which might be required for any new science program, a list of additional resources for Life Lab would include: funding to pay for a wide range of gardening supplies and materials, work on the garden, security for the garden, and teacher training and classroom substitutes; a resource center such as a tool shed or supply room; books and appropriate reference materials. In addition, the school must have outdoor space for the gardening area, and indoor space near windows or for a Grow Lab™. Many of these resources are needed during the start-up phase.

- **Conditions.** Other conditions which are important parts of a successful program are related to: the particular culture and needs of the school, teacher enthusiasm, an appropriate example or model, follow-up support for continued learning, a mechanism for teacher cooperation, and time for implementation. The Life Lab workshops generate teacher enthusiasm, and help the teachers feel more comfortable teaching science. Schools starting their Life Lab programs would benefit from appropriate examples or models of successful programs. In particular, program implementation in the moderate climes of California may be very different than the Life Lab program needs in colder eastern areas, such as Washington D.C. and Massachusetts. Once a program is underway, there is a need for continued teacher education, through additional workshops, or meeting with Life Lab teachers from other schools. It takes at least two to five years to fully develop a Life Lab program. In schools which have fewer resources, or do not make Life Lab a priority, it may take longer or never fully develop.

Ability for teachers to teach Life Lab science

Life Lab helps teachers overcome the first obstacle toward teaching science -- the teachers' own resistance and lack of confidence to doing science. Through the workshops and its curriculum, Life Lab motivates teachers to do science. Teachers working with the Life Lab curriculum are including science in their weekly lessons, and in some cases teach science daily. They are incorporating Life Lab science into their lessons in a variety of ways. The most obvious way they do this is through working in the garden, or doing experiments with plants indoors. But they are also integrating science with other subjects, such as geography, spelling, reading and writing, social studies, and physical education. This integrated or interdisciplinary approach helps the teachers, as well as the students, understand science.

Most Life Lab teachers are not completely prepared for teaching science, because they are inexperienced with teaching science, and have very limited science background themselves. Despite these limitations, the teachers are saying that they want to know more about science, and want to teach it. This suggests that teachers need on-going training and stimulation in science education.

The start-up phase of the Life Lab program can be particularly challenging for teachers. Many teachers, even in the rural areas, don't know much about gardening, or plant science. They have not had garden experiences, or used the tools in the field. The workshops introduce teachers to gardening tools and processes, but the teachers may be on their own after that. What lies ahead, after the training, can be a formidable challenge.

During the program start-up, the curriculum *The Growing Classroom* has been very useful, especially "Book 1, Getting Started." Teachers say they are using some of the lessons from the other books in this curriculum, but are not using many. It is unclear what level of curriculum materials or support teachers want for Life Lab. One principal said that she prefers grade-specific curriculum, built around a developmental sequence of learning. The teachers were less specific.

Students learning of science

Life Lab is having a broad impact on students' attitudes about science, their learning skills and knowledge of science. Students are positive and enthusiastic about science. This was demonstrated in their responses to questions about school, and the vitality they exhibited in indoor and outdoor scientific activities. In addition to these positive attitudes, Life Lab enhances students' self-confidence and builds social skills. A number of people remarked that through working in the garden students learn responsibility, and develop ownership in their work. This is true across the wide range of student behavior, from those who are high achievers to those who are seen as troublemakers.

From these case studies, it is difficult to assess how much science students are learning in the Life Lab program. But the following characteristics of reform science education were observed: hands-on science activities; an emphasis on the process skills of scientific investigation, and an inquiry-based approach to learning using the modified scientific method of "Guess, Test, Tell" (and in some cases using the traditional scientific method); use of multiple resources (such as textbooks, books, newspapers, other curriculum materials, and handouts); journal writing and keeping lab notebooks; applications of their skills and knowledge using record-keeping, math, graphing, charts, analysis, and manual skills. In conversation, students demonstrated their scientific knowledge on some occasions, but were not always eager or open to share their knowledge.

In the garden, and around the indoor Life Lab study areas, students are able to identify and describe their garden projects and research experiments. On many occasions students proudly explained their work and what they were learning. Many of these projects were simply replications of Life Lab experiments, or experiments from other science curriculum. However, a number of projects, such as those for the school science fairs, displayed evidence that students were formulating theories and making hypothesis, and developing experiments to test their ideas. Some students were transferring their knowledge from school into their home, taking seedlings and plants home and starting their own garden.

Is Life Lab science or is it gardening?

The Life Lab science curriculum is promoted as a garden-based science and nutrition program. When I asked teachers and principals "Is Life Lab science or is it gardening?", they invariably replied "Both!". The practitioners agree with the promotion. But the question requires further exploration.

Science is a body of knowledge, and a means or method of analysis. Science education is the study and creation of knowledge, through theory-building and analysis. In reform education, the study of science also includes the study of the relationship between science and society. I will try to answer the question "Is Life Lab science or is it gardening?" by discussing each of these expected outcomes for science education.

- **Body of Knowledge.** The body of knowledge communicated in the Life Lab curriculum is specific to gardening and nutrition. However, students are receiving a broad, interdisciplinary science education, through emphasis on the life sciences. Students are exposed to physics, chemistry, biology, earth science, and astronomy. For example, in the study of soils, students are learning about soil chemistry as well as the physics of soil. In their study of plant and animal interactions in the garden, the students are learning basic ecology. This broad study is enhanced by focused study on plants, gardening, and nutrition. Students study plants in-depth. This overall approach enables students to focus on a subject, and also see the interconnections between that subject and other scientific ideas. This combination of breadth and focus is one of the recommendations by both Linn and The California Department of Education (Linn 1987 and CSBE 1989).

I am not able to assess, from these case studies, if students are getting enough of the body of scientific knowledge. I had no criteria for measuring how much knowledge is appropriate or enough.

- **Method of analysis.** Through a method of analysis students scientists are able to test their ideas, to conduct scientific inquiry. The so-called scientific method has been established as the traditional method of analysis in the sciences. Life Lab uses a modified scientific method, Guess-Test-Tell. I saw evidence that teachers and students are using both of these approaches in their classes. In some classrooms posters on the walls explain the steps in both of these methods, and students' work reflects the application of them. This can be seen in students' work displayed on the classroom walls, in the hallways, in the science fair projects drawn from Life Lab themes, and in student science writing journals and lab notebooks.

- **Theory-building.** Theory building is the development of ideas, toward the development of an understanding of the underlying principles of the physical world. Theory building is the process which often initiates scientific thought and hypothesis, and enables one to synthesize the results of research. There is some evidence that Life Lab promotes this, but it is not explicit. The method of analysis needs to go beyond Guess-Test-Tell, and ask the questions Why? and What Next? Why did the experiment turn out the way it did, and, given what was found, what is the next step for inquiry?

- **Relationship of science to society.** The California State Board of Education recommended that science curriculum present "science in connection with its applications in technology and implications for society" (CSBE 1989). Life Lab does an exceptional job establishing this connection, but it does not go far enough. By focusing on food production, the students learn where food comes from, and are exposed to a sustainable system of food production. Students are involved with community programs, such as the National Zoo, and a Beautification project. Other related issues, such as world hunger, food distribution, and hybrids and crop yield, were not in evidence in the curriculum. Perhaps there is too much focus on the garden, and the broader issues need to be emphasized.

Life Lab transforming Science Education

In some ways Life Lab is a tranformational program, affecting the school, teachers, and students. It can transform the culture of the school, as it did in San Jose. At two of the schools studied, the garden was a very important part of the school's image. Annual celebrations, which involved the school and community, featured the schools' gardens. Teachers have stated that their experience with Life Lab has transformed their teaching. They have moved from a traditional approach to a modern method of teaching. Not only have they adopted hands-on science and cooperative learning, but they have new-found confidence and enthusiasm for teaching science.

Life Lab is also transforming the personal and social attitudes of students. At every school we visited staff commented on this. They said that through the students' experiences in the garden, or working with living things, they gain responsibility, and a sense of ownership of their work and ideas. They are also learning to work cooperatively, to solve problems together, rather than just working individually or competitively.

On a broader scale, Life Lab is making an impact on the educational community as a whole. In every school district included in these studies, there were plans to make Life Lab a district-wide program, in elementary and secondary schools. The San Jose district, which has had Life Lab for five years, will soon have a Life Lab in every elementary school.

Comments on Implementation

Schools are piloting and introducing a number of new science programs now. Many of the science programs at the schools we visited have been selected from among those sponsored by the National Diffusion Network (NDN). Implementing new programs takes considerable effort. Introducing a program with a garden can be even more work. One school, in particular, has done an outstanding effort in its science curriculum implementation.

Each school, in its own way, is responsible for its curriculum development. In the area of science education, the schools are drawing from a variety of programs to help them in their curriculum development efforts. One central feature of these curriculums is that they do not rely on just one program for the entire curriculum. Each school seems to work with more than one approach, using textbooks, teachers guides, special materials teachers gather, and one or more science programs, such as Life Lab. Even at the one school which had a very large, well-developed garden, and had the Life Lab program for 5 years, Life Lab represented, at the most, 50% of the curriculum.

While Life Lab, therefore, is not the entire science program for a school, it has shown itself to be very flexible and adaptable. Teachers easily integrate Life Lab with their teaching goals and activities. Science teaching specialists correlate the Life Lab curriculum with District instructional objectives. Schools choose to make Life Lab a focus for all grades, or just one or two grades. Life Lab is compatible with other science programs or teaching sequences, such as textbooks. A school can have a garden or not, and still do some level of work with Life Lab. For example, at one of the schools which did not have a garden, the teachers still identified very strongly with their Life Lab curriculum.

One characteristic of introducing a new program at a school is that it takes a lot of effort, from many people, to make it work. Implementation may involve district-wide support, volunteers, fund-raising, teacher training, special equipment purchases, and extra space. Life Lab is no exception to this.

Funding for science education was cited by principals as the number one barrier to implementing new programs. Funding for Life Lab has come from a variety of sources, drawing on the skills of teachers and staff people in grant writing, public speaking, community outreach, and lobbying. In San Jose, getting money for Life Lab was included in a community bond measure.

The gardening component of the Life Lab curriculum is essential, and not every school has a garden. All the classrooms we visited had some type of indoor area for growing plants. But only three out of the five schools had gardens. The two inner city schools without gardens dreamed of building rooftop gardens, or large community gardens, but had not yet obtained the resources or support for this vision.

Another challenge to implementation is the seasonal nature of gardening, and the school year. The school year traditionally begins in the early fall and ends in early summer. In colder climates, a garden is traditionally begun in the spring and harvested in the fall. The school year is out of synch with the garden cycle. Despite this contradiction, Life Lab gardens thrive in harsh and warm climates. However, each school is anticipating establishing a summer gardening program. In the past, schools have relied on volunteers to maintain the garden during the summer. This has not proved to be satisfactory to any of the participants. So they are trying to set up programs that pay staff people to manage the garden in the summer.

During the winter the East Coast gardens were dormant, and the amount of indoor garden activity was limited. One school used indoor Grow Labs™ as a means of providing gardening continuity from fall to spring, and this worked very well.

Another possible solution to this cyclical difficulty is year-round school. Although few school districts are presently using a year-round system, one of the schools we studied expected to be on a year-round schedule soon. They thought this would help resolve the problems they were having maintaining their garden in the summer. The students look forward to working in the garden, but they don't like the summer heat.

An exemplary model of curriculum development and program implementation was found at Eastern Elementary School. The principal at Eastern has taken a very active role in shaping the school's science curriculum. She has a long-term vision for curriculum development, expecting that it will take years to get a complete science program in place. She envisions a curriculum that accounts for the stages of cognitive development of her students. She informs herself about what programs are available, and follows her instincts in selecting programs. Most importantly, she actively involves the teachers in developing and implementing the curriculum. The teachers work informally in teams helping plan the scope and sequence of the curriculum, selecting the science programs for evaluation, testing the materials and approaches, and refining the end product.

This approach helps guarantee the success of a science curriculum at many levels. By having a vision the principal can see beyond the day-to-day pressures and choices that principals constantly face. By informing herself, she doesn't rely on educational experts to tell her what to do. By involving teachers, she lets the real experts decide what works from practical experience, enabling her teachers to have control and ownership over the curriculum as well.

In a relatively short time, Life Lab has become institutionalized, and made substantial growth at this school. Nearly all of the teachers have been trained by Life Lab. A large outdoor garden has been built, and an indoor gardening component, using Grow Labs™, is in place. All third and fourth graders will have Life Lab science. And plans are in the works for a summer gardening program, using parents and community volunteers. There are also plans for continuing the garden-based science program at the high school level. In the immediate future Eastern Elementary will have a year-round Life Lab science program that potentially impacts all of the students in the Eastern Public School system.

CHAPTER 6 CONCLUSION

When I was in elementary school I had very little science. But I can vividly recall one experiment that had a profound impact on my life. It was an experiment on water purification in my fifth grade science class. The teacher brought into class a small glass of brown water from the creek next to the school, one of the most polluted creeks in our industrialized city. She poured the water into a filtration system she had constructed, and asked us to explain how the filtration process worked. While we generated ideas and theories about what was going on in the filter, the water moved slowly from one end of the filter to the other. After several minutes, clean water trickled out into another glass. The teacher asked if anyone was brave enough to drink the water. No one volunteered. I squirmed in my seat, caught between my natural urge to volunteer for anything, and my disbelief that the water was actually potable. Finally, I raised my hand, walked slowly to the front of the room, and took the tiniest sip from the glass. The water had a bitter taste and smelled funny. I announced it tasted "Great!", and the class broke into applause and cheers.

This event serves as a landmark for me, and my interests in science, conservation, and the environment. It illustrates how powerful one science activity can be. Yet, in so much of young people's education today, the brilliancy of science -- of discovery, experimentation, and theorizing -- is lost in a haze of textbooks, memorization, and poorly equipped teachers.

In this chapter I discuss what is needed in elementary science education, and the strengths and weaknesses of the Life Lab program.

As stated in Chapter One, we are experiencing a crisis in science education. Textbooks are overused as the source of knowledge, memorization of facts and formulas rather than experiential knowledge are emphasized, and testing encourages students to look for the "right" knowledge, rather than one they create or own.

I began this research thinking that the Life Lab Science Program held a solution to the crisis in science education. I thought their model of a practical, applied, garden-based science program that emphasized hands-on activities and cooperative learning, provided the necessary ingredients for a solid foundation in science.

What I found, through observing classes and schools, and talking with many people in these schools, is that the solution is much more complex than a new science program. This research contains many very good generalizable elements about the strengths and weaknesses of the Life Lab Science Program. But it also leaves unanswered important questions.

Life Lab's greatest strength, at present, is that it is an experiential program that motivates teachers and students to become interested in science. People get their hands dirty and learn about growing plants. This appears to appeals to all people. It helps loosen teachers straightjackets about how to teach science, or the fear they have about teaching science, and enables them to join in the enthusiasm of an active, participatory science program.

Life Lab is adaptable, as can be seen in these schools in such different settings. One school may take on Life Lab as a whole science program. At Marsh Elementary , Life Lab has helped create a new identity for the school built around the garden. Another school, such as Eastern, draws what it needs from the Life Lab program, but relies strongly on other science programs to round out its curriculum. In Washington D.C., teachers are adapting Life Lab to fit within the formal guidelines mandated by the District.

Another strength of the program is its integrated approach to curriculum, and use of cooperative learning techniques. An integrated curriculum helps teachers bring in science topics more easily, and to devote more time to science instruction. Both of these teaching strategies are more popular today than 10 or 20 years ago when many of these teachers began their careers.

Another one of the important things offered by the Life Lab program is the sense of caring and ownership the students get, that comes from working with living things. From the experiences and responsibilities they have taking care of plants and working with soil, students gain an appreciation for the Earth, the living environment. They also gain a sense of self-worth and ownership from being part of something living that they helped create. They take pride in their work, their produce.

It is more difficult to assess what level of inquiry and discovery learning is taking place in the Life Lab program. Many of the Life Lab activities encourage investigation and experimentation. However, an inquiry approach runs counter to the traditional classroom teaching model. The challenge here is in changing teaching methods, moving from a style which is teacher-centered or directed to one in which the students have more responsibility and ownership of their ideas and inquiry.

The more critical question is: "Is it science or is it gardening?" I believe that Life Lab is both science and gardening. The gardening aspect of the program is very strong, but the science aspects of the program need to be strengthened.

A good science program has at least four main goals: the communication of a body of knowledge; the process of scientific inquiry, or a method of analysis; theory building or the discovery of natural laws; and the real world connection, or an understanding of the relationship between science and society. Life Lab is off to a good start in each of these areas, but it could be improved. Life Lab needs to focus more on genetics, which is at the leading edge in the field of biology. Through the process of scientific inquiry students should be encouraged to reach further with their ideas than they through Guess-Test-Tell. They must ask Why? and What next? The Life Lab curriculum emphasizes organic and small-scale gardening. Building on this knowledge base, it should bring in the major issues of world hunger, food production and distribution, and sustainable agriculture.

The most significant barrier in elementary science education is the teachers' fear of science. Once this barrier has been overcome, teachers will have the opportunity to really learn science, and the natural inquiry of children will be allowed to blossom. Perhaps Life Lab's greatest asset is that it enables teachers to overcome this fear. But one workshop is not enough. Teachers need ongoing training, workshops, and support. Life Lab plants the seed and helps it sprout in each teacher, but its going to take a lot more effort from many other people to help that seedling grow through to harvest.

The purpose of this research was to take a broad look at the Life Lab Science Program as it is being implemented in a range of schools, to answer the question "What is the nature of Life Lab in the school setting?". I found that science education is becoming more important in elementary school curriculum. Life Lab motivates teachers and students to become interested in science. It is adaptable in a variety of socio-economic and geographic settings, and can become an important part of the school's culture. It has a wide range of levels of implementation, depending largely on the goals and leadership at the particular school.

APPENDIX A. ORIGINAL SET OF INTERVIEW QUESTIONS

Life Lab (LL)
The Growing Classroom (TGC)

The School in the Community
School statistics
School Demographics
Other schools in the community

LIFE LAB IN THE SCHOOL CONTEXT

General
What are the schools overall educational priorities, goals and direction? How are they being attained?
What are the educational priorities in the school?
How does science education fit in with the school's overall educational goals and direction?
What are the science teaching priorities at the school?
Do they use science programs other than LL?
What efforts are being made for improving science?
What role has LL played in influencing the schools overall science goals and direction, and educational goals and direction?
Is social studies a part of the science teaching?
What other subjects is science or LL integrated with?
Does the curriculum feature Science/Technology/Social issues?
Can teachers see their science program be based around LL year-round, and year after year?
How does LL spread into other classes or programs in the school?
What is the role of the NDN state-wide facilitator? Has the school worked with the facilitator? the State Dep't of Education?

Adoption of LL
How did you find out about LL?
When did the school adopt LL?
Why was LL adopted at the school? or How was LL chosen for the school?
What mechanisms or process were followed to adopt LL?
How was LL set up in the school curriculum and program, implementation, management, site development?
What are the difficulties of establishing and maintaining a LL program?
How are the constraints overcome, or not overcome?
Who participates in the LL program at the site?, and how initially?
How as participation changed through the years?

Administration

What is the administrations perspective on having LL at their school, or in their district?
How is the administration involved with science education?
How is the administration involved with LL?
What specifically are they doing or not doing to support LL at the school?
How does the administration view their role in helping make Life Lab successful?
Does the administration think LL science will work throughout the whole school? Are they already involved in school-with LL science?
How does the administration view parents and other volunteers' roles in Life Lab?
Advice to other classes or school districts, concerning program adoption and implementation?
Administrative points of view: school board, superintendent, principal

Aides
Are there any aides working in the LL program?
What does the aide do?
What happens to the teacher's role with LL when an aide is hired?
What happens to the organization of the LL program and curriculum when an aide is hired?
How is the aide position funded?

Parent and community involvement
Are there any parents and other volunteers in the program?
How are parents and community members involved with the school, and LL?
How is the parent and community involvement important ?
How much energy does it take to be involved? (effort, projects, leadership, communication, organization) or How much coordination does it take on the school's part?
How do the parents and volunteers participate? What do they do?
How does their involvement get started?
What are strategies for recruiting people to be involved with LL?

SCIENCE TEACHING, PRESENT PRACTICES

General Principles
How much science is taught now?
How much time is spent on science each week?
Is other science taught in addition to LL? How are these multi-science curriculum efforts organized?
Does the science teaching vary from teacher to teacher, how?
What percentage of the science taught now is LL?
Would you like to teach more science?
What would help you teach more science?

What are the important things about the LL program that make a difference in your science teaching, or at your school?
What is it that makes science teaching difficult?
What are the crucial barriers?
To what extent does LL address these barriers?

Life Lab Science
How is LL integrated with the rest of the class curriculum?
or What carryover is there from LL into other parts of the curriculum (e.g. inquiry, thinking, observation)
How much time per week is spent on LL? in garden lab, in classroom, off-campus, other?
How well do they integrate garden activity with inquiry science? with The Growing Classroom?
Who teaches LL in the school? (an aide, teacher, or science specialist, a paid employee or volunteer, other?)
How does LL get maintained? Supplies ordered, schedules coordinated? Who is responsible for coordinating the teaching program?
How are the lessons structured during LL time?
What's the structure like when students are engaged in LL activities? How are the activities managed?
What kinds of activities are students involved in when they are doing LL? Are they asking questions, working in groups, moving around to resource areas, other?
Do the teachers use cooperative learning strategies when they teach LL science?
How much of the structure and management do teachers want relayed to them, in workshops or teaching materials, in LL?
How do students record their work? (journals, class lab notebook, other, group, individual, class)
How do teachers monitor and evaluate students work?

CURRICULUM

General
How has the LL curriculum been implemented?
What are the teachers and aides actually doing with the curriculum?
What would you like to see added to the curriculum--subjects, materials? Please describe.
How much does the teacher use the community for teaching? In what ways?
What community resources do teachers make use of? (coop ext., 4-H, Garden clubs, other)
Are the LLSP newsletters useful? How?
How else has the LLSP been helpful?

The Growing Classroom

Does the school use the curriculum materials, The Growing Classroom, in the Life Lab program?
Specifically, how are these materials used?
How are The Growing Classroom lessons divided by grades? or Which lessons from TGC are taught at which grade levels?
How many of the units The Growing Classroom are used?
Is there enough background information in The Growing Classroom per lesson?
Is there enough science in the LLSP materials?
What do teachers like about The Growing Classroom?
What are the problems, constraints with using these materials?
How would teachers like to see these materials expanded, changed?

Garden Laboratory
Does the school have a garden laboratory and how is it used?
Does the school or class have an indoor garden lab, science program? What are some examples of this?
Does the class use the garden as an on-going science lab?
What does the garden look like? How is the garden layed-out? What are the dominant components?
see other documentation on describing garden sites
What are the greatest benefits of the garden?
What are the greatest problems of the garden?

IMPACTS OF LL ON TEACHERS AND STUDENTS

Teachers--Attitudes, Knowledge, and Skills
How has LL influenced the teachers attitudes, knowledge, and skills towards science education? Towards general education? Towards themselves personally?
Have teachers attitudes toward teaching changed since using LL? If so, how?
Is LL science or is it gardening or what?

Students--Attitudes, Knowledge, and Skills
What are the students attitudes toward science? How has LL influenced the students attitudes, knowledge, and skills?
Are the students turned on to science?
How do the students see science? is it the garden? or How do the students interpret the science portion of their curriculum?
Is LL science or is it gardening or what?
What is exciting about science for the students?
What do students like about LL science?
Do students look forward to LL time?
What do students consider to be LL time? (ex. indoor science, outdoor science, gardening, other)

EVALUATING THE DIFFERENT ASPECTS OF LL

LL Inservice Workshops

What was your experience with the LL inservice?
Was the inservice effective for introducing the LLSP and its approaches?
How as LL implemented at the school after the teachers returned from the training workshop?
How can the LLSP staff get more input from you on your science program?
How can they give you more input on your science teaching?
In what ways could more communication between LLSP and your school be helpful?

General Issues

Future needs and possibilities?
What might LL do to promote itself further?
Where does LL go in the school?
Who participates in LL training workshops?
Why do people come to the workshop?
Are workshops effective?
What are the strengths and weaknesses of the workshops?
How much time should be spent in the workshop?
What could be taught in follow-up workshops, additional LL inservices?
How do the workshops meet the needs of the participants?
What are the barriers that teachers face when they are back in the schools?
Would LL teachers or the LLSP benefit from holding meetings for experienced LL teachers?
After initial inservice workshops, should LL do follow-up? Should it be held for an individual school, district, or teachers from many districts?

Follow-up Services

Would additional training benefit the school's program?
Who will pay for the additional training?
How much money would schools be willing to pay workshops, materials, ongoing support?
Who pays for the components-training, tools, site development, special materials?

Costs and Funding

What are the real costs to the school of operating a LL program?
Who pays for these costs?
What is the process of funding LL, who is involved?
How are the dollars acquired?
Who finds the funding?
What is the relationship between the parents and community and the funding of LL?
How can school districts afford to pay for LL?

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